REPORT RESUMES

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SURVEY OF INFORMATION ON VOCATIONAL AND TECHNICAL EDUCATION
IN THE STATE OF ILLINOIS. FINAL REPORT.
CORPLAN ASSOCIATES, CHICAGO, ILL., TECHNOLOGY CTR.
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THE BASIC OBJECTIVE OF THE SURVEY WAS TO GATHER INFORMATION HELPFUL IN PLANNING AND DEVELOPING VOCATIONAL AND TECHNICAL EDUCATION PRIMARILY WITHIN THE PUBLIC SCHOOL SYSTEM. OCCUPATIONAL NEEDS WERE IDENTIFIED FROM FORECASTS OF CHANGES IN CURRENT OCCUPATIONS, AN ANALYSIS OF THE IMPLICATIONS OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENTS, AND DISCUSSIONS WITH EDUCATORS, BUSINESSMEN, GOVERNMENT OFFICIALS, UNION OFFICERS, SCIENTISTS, AND ENGINEERS. SAMPLE JOB DESCRIPTIONS, AS THE BASIS FOR DETERMINING THE VOCATIONAL SKILLS AND EXPERIENCES REQUIRED FOR SUCCESSFUL JOB PERFORMANCE, PRESENTED THE EMPLOYMENT OUTLOOK, OCCUPATIONAL SKILL REQUIREMENTS, AND IMPLICATIONS FOR PROGRAM PLANNING FOR NINE KEY INDUSTRIES--PRIMARY METALS, HEALTH SERVICES, PRINTING AND PUBLISHING, ELECTRONICS AND ELECTRICAL EQUIPMENT, AGRI-BUSINESS, FOOD PROCESSING, CHEMICAL PROCESS, METAL WORKING, AND OFFICE. IT WAS CONCLUDED THAT (1) FUTURE SKILL REQUIREMENTS OF MOST EMERGING, EXPANDING, AND CHANGING OCCUPATIONS WILL REQUIRE FORMAL EDUCATION IN ONE OR MORE OF FOUR CORE CURRICULUMS, (2) PROGRAMS TO TRAIN ELECTRONICS AND HEALTH INDUSTRY PERSONNEL SHOULD RECEIVE HIGH PLANNING PRIORITY, (3) IMPROVED LABORATORY FACILITIES SHOULD BE ADDED TO SECONDARY SCHOOLS, (4) PRACTICAL ENGLISH COMMUNICATION AND TERMINOLOGY COURSES WOULD ELIMINATE A KEY FAILURE OF VOCATIONAL EDUCATION GRADUATES, AND (5) ADDITIONAL RESEARCH MUST BE UNDERTAKEN ON SUBJECTS SUCH AS REGION-BY-REGION STUDIES OF THE SIZE AND NATURE OF INDUSTRIAL PLANTS, AND MANPOWER NEEDS FOR FARM-RELATED OCCUPATIONS. (SL)

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CONSULTANTS TO MANAGEMENT

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RESEARCH AND DEVELOPMENT COORDINATING UNIT
ILLINOIS BOARD OF VOCATIONAL
EDUCATION AND REHABILITATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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I. INTRODUCTION

I. INTRODUCTION

This report has been prepared by Corplan Associates, an affiliate of IIT Research Institute (formerly Armour Research Foundation), for the Research Coordinating Unit (RCU) of the Vocational and Technical Education Division of the State of Illinois Board of Vocational Education and Rehabilitation. The RCU authorized the survey as a subcontract under a general contract (O.E.-5-85-126) with the U.S. Office of Education. It is intended to help those persons concerned with education in Illinois at the state and local level and those in institutions of higher education who are seeking literature as a basis for further research or for solutions to present problems in vocational and technical education.

The basic objective of the survey was to identify and gather information helpful in planning and developing Vocational and Technical Education (hereafter referred to as V&TE) in the state. The two major subobjectives were

- To identify the present and emerging occupations in Illinois for which youth should be trained
- To develop recommendations on how existing information gaps can be eliminated through subsequent research

During the course of the survey individuals representing many institutions and points of view were interviewed and consulted. Constructive ideas and suggestions were obtained from educators, businessmen, government officials, union officers, scientists, and engineers. Interviews were conducted with representatives of many organizations, including

- University V&TE personnel
- Local school systems
- U.S. Office of Education
- U.S. Department of Labor

- RCU staff and other V&TE staff members
- Illinois Department of Labor
- Private vocational and technical institutes

The survey's main focus is the impact of technological changes expected over the next decade on occupational needs of industries in Illinois. Changing knowledge and skill requirements can be met in a variety of ways, each important in its own right. Although the survey is directed primarily toward the prerequisites for the training of youth and adults within the public school system, the study team is cognizant of the complementary role played by manpower training and retraining programs, especially those conducted under MDTA auspices.

Consistent with the broader vocational education scope envisioned by the Vocational Act of 1963, the following nine areas of inquiry were identified early in the survey:

- The present and emerging occupations for which people should be trained
- The content of new and revised course curriculum
- The supply of teachers
- The guidance and placement services
- The needs of low-achievers and potential dropouts
- The role of post-secondary education
- The status and prestige of V&TE
- The role of V&TE in adult education
- Organization, administration, and control of V&TE

The first two areas received major emphasis and are discussed in each of nine subchapters devoted to Illinois industries. The remaining areas are discussed in Chapter V.

Occupational data was obtained for industries selected on the basis of susceptibility to technological change and magnitude of total employment. During the industry selection process and the subsequent conduct of the study, Corplan's previous research on the topic of technological change was used as a foundation. Specific references to prior studies will be found in the textnotes. For each industry, data is presented on the employment outlook, occupations and their skill requirements, and implications for program planning.

Under separate cover, a BIBLIOGRAPHY OF PUBLISHED AND UNPUBLISHED VOCATIONAL EDUCATION LITERATURE has been compiled. The volume contains over 1500 citations, subject, and key word indexing, and numerous bibliographic contributions obtained from educators and researchers in 30 states.

Corplan Associates wishes to acknowledge the assistance of the many persons who contributed information to the survey and express a special debt of gratitude to the project Steering Committee members: Messrs. V. E. Burgener and George Fuka of the RCU and Mr. Alan Brimm of the Illinois State Employment Service.

II. SUMMARY OF MAJOR FINDINGS AND CONCLUSIONS

II. SUMMARY OF MAJOR FINDINGS AND CONCLUSIONS

This section presents the major findings and conclusions resulting from the intensive analysis of future occupations for which V&TE students should be trained and the information obtained on other aspects of V&TE.

A. MAJOR FINDINGS

National occupational trends as outlined by the U.S. Department of Labor point to an increasing share of the labor force for technical, clerical, and service workers and a decreasing share for semiskilled and unskilled workers. Exhibit 1, page 5, summarizes a recent forecast of manpower needs by 1975 for major occupational groups.

The occupational trends of Illinois industries reviewed below generally conform to the national picture. When trends are established by industry and state, differences between industries and between national and local trends are observed. In the paragraphs below, which summarize industry findings, both similarities and differences are highlighted.

Chapter IV contains detailed discussions of each industry and the conclusions section of this chapter indicates those industries which should receive program planning priority.

Primary metals industries in Illinois will grow between two and three times the national average as a result of rapidly expanding midwest steel markets and new mill facilities planned or under construction. Technological change will create some new occupations and will change the skill requirements of many others.

Exhibit 1

NATIONAL MANPOWER NEEDS BY 1975

Occupational Group	Percent Change in Numbers Employed 1965-1975
Professional, Technical	+40
Managers, Officials, Proprietors (except farm)	+25
Clerical Workers	+33
Sales Workers	+20
Craftsmen, Foremen	+25
Operatives (semiskilled)	+15
Service Workers (barbers, hospital attendants, waiters)	+40
Farm Occupations	-25

Source: Stambler, Howard, "Manpower Needs in 1975," *Monthly Labor Review*, April 1965, Vol. 18

The program planning implications of technological change include

- Development of specialized business education courses for mill record keepers
- A trend of replacing college graduates with technical program graduates on shift work
- Increasing technical qualifications for nearly all workers concerned with primary metals production

Health service jobs from the licensed to the aide categories should double during the next decade according to national projections by the U.S. Public Health Service.

The impact of medical electronics has helped to create new occupations and expand still others within the industry. Three implications for program planning were found:

- New sources of manpower supply will be required to meet future demand.
- Secondary school courses in health services subjects could provide training for entry jobs and a foundation for post-secondary training.
- A lack of articulation is evident in existing training programs.

Printing and publishing industry sales are expected to grow at an annual rate of 4-5%. This growth will be offset by a nearly commensurate increase in manpower productivity. Accordingly, additions to the labor force will be small. Replacement requirements will be high due to an average journeyman age of nearly 50. Problem-solving skills will replace trial and error techniques in composing and pressroom operations. The trend toward color work and offset equipment will require a chemical (darkroom and color separation) background for increasing numbers of employees.

Electronics and electrical equipment industry employment will grow faster than any other sector except health services. After taking into account productivity gains, an annual rate of 4% or more can be expected. Employment in industrial electronic controls firms can be expected to grow at approximately 8% per year.

Minimum technology electronics jobs require less than one year of post-secondary training if an adequate high school background is provided. A core high school electronics orientation would permit graduates to enter on-the-job training, apprenticeship programs, and other vestibule job opportunities in numerous industries.

Agribusiness employment in off-farm occupations is increasing while on-farm employment is decreasing. Research should be performed to determine the future supply and demand for agricultural implement mechanics for the next decade.

Food processing plants in the state will experience modest sales and productivity increases. The frozen and convenience foods sectors will grow nearly 10% per year and the school systems in areas where these plants are located will be called on to provide graduates qualified for quality control, commercial home economics, and process control maintenance occupations. In the bakery products sector, specialty food bakers and those concerned with quality control should be proficient in making chemical tests of acidity, texture, fat composition, and bacteria count.

Chemical process plants generally will experience process automation and instrumentation serving to increase manpower productivity as rapidly as sales. In contrast, ceramic, plastic, and adhesive plant employment will rise significantly. Process automation, instrumentation, and the proliferation of custom blended chemicals will increase the operating and maintenance skill requirements of occupations in the industry.

Metalworking, an occupational group covering machining operations performed in a number of industries, will be affected by innovations the most important of which is numerical control (N/C). High school level courses are feasible for numerical control programmers and machine tenders.

This development will not make present high school or area technical school machine shop facilities obsolete since at least one-half of all machine tools will not be converted to N/C and since experience and skill gained on conventional machine tools will provide the background required by all N/C occupations. Approximately 500 "parts programmers" per year will be required in the state.

Office industry occupations are prevalent in nearly every sector of commerce and industry--insurance, banking, manufacturing, retailing, etc. Total industry employment will rise nearly 4% per year over the next decade. Many office occupations with a prerequisite of highly skilled background will emerge--technical secretary, medical secretary, engineer's aide, archive and library specialist, and information collection and retrieval specialists.

B. CONCLUSIONS

The Future Skill Requirements of Most Emerging, Expanding, and Changing Occupations Will Require Formal Education in One or More of Four Core Curricula.

In general, the cognitive portion of technical and production jobs is increasing and the importance of manual and sensory skills is declining. This trend places emphasis and priority on an early combination of applied scientific principles and related basic education. These applied principles should be melded in the classroom and the laboratory. In the opinion of those interviewed, high school is the point at which the initial background should be provided. Applied chemical and mechanical principles could prepare a student for entry jobs and post-high school technical training in the chemical process industry, the health service industry, the food process industry, the printing and publishing industry, and the agribusiness industry.

One core curriculum would typically include basic chemical test procedures, acid solution analysis, composition of emulsions, introduction to food chemistry, with other subjects.

A second core curriculum would introduce the student to the fundamentals of electricity as well as electronics and electronic terminology. A sequence covering several semesters would include basic electrical theory, similar to the subject matter of high school physics courses but on an applied level; basic circuit theory; and an introduction to radio transceivers and electronic control mechanisms. This sequence of courses would prepare students for maintenance, design, and operation occupations in the electrical equipment and electronics manufacturing fields and all user industries.

A third core curriculum covering mechanical and hydraulic fundamentals could be added to or included in an existing shop curriculum. Positions such as millwright, control technician, maintenance technician, electromechanical service technician, and agricultural implement and tractor mechanic require an understanding of fluid power mechanisms, servomechanisms, and other similar devices.

A fourth core curriculum would serve occupations in health services. Such a curriculum is justified by the rapidly increasing demand for subprofessional health manpower. One or two courses in medical terminology, procedures, and basic anatomy would be a minimum education foundation which could be offered at the high school level.

Programs To Train Electronics and Health Industry Personnel Should Receive High Planning Priority

Each of the nine employment sectors studied has a growing need for V&TE trainees. When the nine sectors are considered in the light of such factors as growth of manpower demand, opportunity to develop new programs, and evidence of industry's willingness to cooperate, the electronics and health services industries should be given priority in program development and planning.

Existing public and private vocational and technical institutes are unable to meet the demand for electronics technicians and maintenance jobs opening up in nearly every manufacturing industry and in many service industries. Manpower needs in some sectors will grow nearly 10% per year during the next decade.

United States Public Health Service projections call for a continuation of the trend established during the past decade of technical and semitechnical manpower growth, which exceeded 10% per year. Expanding occupational groups include entry jobs for high school enrolees, high school graduates, and technical jobs requiring as much as three years of post-high school training.

Both electronics and health services industries offer the opportunity to develop new V&TE courses unfettered by past approaches and traditions.

Improved Laboratory Facilities Should Be Added to Secondary Schools in Most Parts of the State

Addition of relatively inexpensive laboratory apparatus to provide applied science laboratory courses (chemistry-food technology) and construction of entirely new laboratories (electronic) should be made in local high schools. The high cost of modern equipment in industries such as printing and publishing (see program planning implication sections of individual industry discussions for details) suggests the use of area technical schools for secondary and supplementary adult education courses to keep costs per pupil at a reasonable level.

Practical English Communication and Terminology Courses Would Eliminate a Key Failure of Vocational Education Program Graduates

Interviewees frequently cited the inadequacy of English and communications skills among vocational education graduates entering apprenticeship programs, entry jobs, and post-high school associate degree positions. For example, a farm service manager cited employee difficulties in writing business letters and memos. We suggest that additional specialized English and communications courses programs be developed. These courses should emphasize

- Vocational terminology and expressions
- Business letter and report writing
- Role and status of V&TE personnel
- Technical writing

Additional Research Must Be Undertaken To Provide Definitive Answers to Planning Questions Because a Number of Information Gaps Now Exist

Chapter VI of this report outlines several research projects designed to fill the key information gaps made apparent by this survey. The nature of these projects strongly suggests that they be executed by or under the auspices of a state organization, such as the Division of Vocational and Technical Education. The recommendations outlined are based on the need for a comprehensive analytical approach to manpower studies and the use of task forces to handle major new programs.

III. METHODOLOGY

The methodology followed in the survey is designed to identify information and information gaps relevant to vocational and technical education planning problems such as

- . How will the skill requirements of subprofessional jobs change due to evolving technology and automation?
- . How many jobs will exist at what future points in time?
- . Where and on what scale should vocational and technical education facilities be located?

This chapter discusses the selection of employment sectors and vocational and technical education problems surveyed, how the information was gathered, the general format for the presentation of material on each employment sector, definition of key terms, and methods used to generate specific data.

Information has been developed and information gaps explored to the extent possible in a general survey--the study team hopes that the methodology employed and here explained will form a sound basis for subsequent studies performed by occupational researchers.

A. SELECTION OF EMPLOYMENT SECTORS AND VOCATIONAL AND TECHNICAL EDUCATION PROBLEMS

III. METHODOLOGY

Employment sectors experiencing a high degree of technological change and likely to be significantly affected by future technological developments were initially identified; then the nine largest sectors in terms of total workers employed were selected. These sectors were then subjected to a preliminary review to identify the major occupational implications of the respective technological changes. During the selection process Bureau of the Census employment, output, and value added by manufacture data listed by county and Standard Industrial Classification

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Vocational and technical education problem areas were identified during interviews conducted with firms hiring vocational and technical education graduates, vocational and technical educators and researchers, Department of Labor personnel, higher educators, and other interested parties, including students. The problem areas thus identified and listed in the introduction served as a basis for a preliminary literature search.

B. HOW INFORMATION WAS OBTAINED

Information was gathered during more than 50 interviews with executives concerned with technological change. Business executives, union officials, scientists, technical researchers, educators, the Office of Education personnel, and Department of Labor staff members were interviewed. A substantial amount of additional information was generated during an extensive literature search conducted in conjunction with the bibliography of vocational and technical education literature described briefly in the introduction--details of the literature search are discussed in the introduction to the bibliography.

C. THE GENERAL FORMAT FOR THE PRESENTATION OF INFORMATION

A chapter has been devoted to each employment sector, information developed on the various sectors generally covering topics such as

- The magnitude of changes in total industry employment
- The nature and specifics of occupational change
- Sample job descriptions

7. Subprofessional occupations--occupations which typically can be performed by persons who have not earned a baccalaureate degree

8. Vocational skills--skills learned largely through manual processes and applied cognitive processes

E. METHODS USED TO GENERATE SPECIFIC DATA

The procedures employed in generating information are discussed below. In a world of rapidly changing conditions, it is difficult to provide specific measures of the future effects of technology on manpower requirements. Nevertheless, it is possible to identify those technological developments that will be significant and to provide some measure of their influence. It should be noted, however, that the quantitative estimates presented in this report reflect ranges of values and time periods which, for the sake of brevity and clarity, generally are represented by a single best estimate figure.

Occupational needs have been identified by forecasts of changes in current occupations, by analysis of the implications of scientific and technological developments, and through discussions with interviewees.

Sample job descriptions are included as an example of one method useful in identifying and describing the principal elements of the job and the basic and vocational skills and experience required for successful job performance. These descriptions are intended to be abstractions; the job duties and performance requirements will vary somewhat depending on the specific time and location at which they are implemented.

The establishment of a general order of magnitude of future additions to industry employment necessitates the forecasting of two key factors--sales (or production) and manpower productivity. Sales forecasts may be based on previously compiled data; they may also be based on new data developed through personal interviews or other primary sources. Available data sources include the following:

- Predicasts
- Federal Reserve Board industrial production indexes
- U.S. Department of Labor and U.S. Department of Commerce gross national product forecasts
- Trade association, union, and company forecasts

Manpower productivity information is less frequently found in available literature and in this report is based upon informed opinions of those interviewed and past Corplan study findings. The net effect of changes in sales and manpower productivity provides an estimate of employment additions.

In this survey national trends have been applied to Illinois after due consideration of differences between the national industry and that of Illinois. It would be desirable to develop individual sales and manpower productivity information for the state alone as a basis for precise manpower planning and the determination of when and where to build vocational and technical education facilities. Detailed information for the state would also provide an opportunity for the concurrent development of data on replacements for, as well as additions to, the labor force.

The methodology explained above has been used in developing the economic and employment data presented in the chapters covering specific industries.

IV. MANPOWER AND EMPLOYEE SKILL REQUIREMENTS OF NINE KEY ILLINOIS EMPLOYMENT SECTORS

- THE PRIMARY METALS INDUSTRIES
- THE HEALTH SERVICES INDUSTRY
- THE PRINTING AND PUBLISHING INDUSTRY
- THE ELECTRONICS AND ELECTRICAL EQUIPMENT INDUSTRY
- THE AGRIBUSINESS INDUSTRY
- THE FOOD PROCESSING INDUSTRY
- THE CHEMICAL PROCESS INDUSTRIES
- THE METALWORKING INDUSTRY
- THE OFFICE INDUSTRY

IV. MANPOWER AND EMPLOYEE SKILL REQUIREMENTS OF NINE KEY ILLINOIS EMPLOYMENT SECTORS

PRIMARY METALS INDUSTRIES

A. ABSTRACT AND INTRODUCTION

Illinois primary metals production consists mainly of finished and semifinished steel products. Aluminum, copper, and zinc smelting plants are also located within the state.

Because of the rapidly expanding midwest market and new sources of iron ore, Illinois steel production and shipments should grow between 2 and 3 times the national average over the next 5 to 10 years. The impact of technological change on manpower productivity will be significant, but substantial increases in employment will still occur.

Three major technological changes will affect the steel industry, each of which will create new occupations and change others. Modernization of central Illinois foundries and zinc smelters will also occur.

Implications for program planning include

- Development of specialized business education courses for mill record keepers
- A trend of replacing college graduates with technical program graduates on shift work
- Increasing V&TE qualifications for nearly all workers concerned with primary metals production

B. GROWTH OF INDUSTRY EMPLOYMENT

The national primary metals industry generally is considered to be relatively stagnant. In contrast, growth of Illinois steel production is expected to be significant for several reasons.

- Downstate steel and copper firms are planning or have initiated expansion and modernization programs.

- A new integrated steel mill at Hennepin is expected to employ over 1500 by 1970.
- The midwest steel market is expanding rapidly.
- Midstate and Chicago metropolitan area steel mills, foundries, and zinc smelting facilities are expanding.

Illinois production shipments are therefore expected to grow at 2 to 3 times the forecast national average of 1.5% per year over the next decade. An assumed growth rate of 4% per year is used in the computation below.

Manpower productivity of steel industry employees was was examined in a previous Corplan study and its growth in Illinois forecast to be 1-2% per year.

Evaluation of expected production and productivity growth trends yields a forecasted increase in employment from 1965 levels of 105,000 to 130,000 in 1975 (a growth rate 2.5% per year).

C. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

Nearly 80% of all steel workers are employed in the three major processing operations--blasting, converting, and rolling and finishing--involved in making finished and semifinished steel products from iron ore. Each of the three processes will be affected by one or more technological developments over the next decade.

Blast furnace operations will be subject to more instrumentation and computer control, more use of concentrated iron ores, and more supplementary fuel injection. Operating personnel will be aided by programmed furnace charging (selection of ore, coke, and limestone mix) and feedback controls.

Converting iron ore into steel will be done to an increasing extent in basic oxygen furnaces (BOF) and electric furnaces.

These will replace much of the present open-hearth furnace capacity over the next decade. BOFs are being installed in several Illinois mills including those at Granite City, South Chicago, and the mill under construction at Hennepin.

Rolling and finishing operations will be automated and subject to closed-loop controls to an increasing extent. Most Illinois mills are currently operating, constructing, or planning computer controlled hot strip mills. Continuous casting techniques will eliminate the necessity of cooling and temporarily storing in ingots the steel produced by the converting furnaces. Instead, molten metal is fed directly from the furnaces to the rolling mill. Accordingly, jobs associated with reheating of ingots--pit-man and second helper--will be eliminated.

These technological changes and their occupational implications are expected to occur continuously over the next decade. Direct reduction of iron ore (elimination of the blast furnace step), a frequently discussed innovation, is not likely to have a significant impact during that period. Emerging and changing occupations are listed in Exhibit 2, page 20.

1. The Nature and Skill Requirements of Emerging Occupations

The increasing complexity and more pervasive use of instrumentation and control devices has resulted in a job entitled control specialist. Instrument repair (knowledge of mechanical and thermal measurement devices) and electronic equipment maintenance (feedback links and automated process adjustments) skills are combined to enable a single individual to service all subsystems of control devices used in blasting, converting, and rolling operations.

These devices measure such factors as furnace temperature, lance height, fuel injection, and pressure. They activate flow controls and data recording systems.

Exhibit 2

STEEL INDUSTRY OCCUPATIONS

Emerging

Control Specialist

Closed-Loop Control Technician

Automated Strip Mill Record Keepers

Metallurgical Technician

Powder Metallurgical Technician

Continuous Casting Technician

Oxygen Furnace Operator

Changing

Roughing Mill Operator

Furnace Operator

Coiler Mill Operator

Melter

First Helper

Millwright

a. Closed-loop control technicians specialize in computer controls and on-line or off-line adjustment mechanisms used in automated rolling and strip mills.

b. Automated strip mill record keepers record the gauge, width, length, and run-off tolerances of each actual production run and make comparisons to customer order data. This function is important since it is the only human check of the computer controlled production runs and is the only complete record of mill activity kept on a perpetual basis. Records are kept at the beginning and end of the line to facilitate the identification of the start and completion of each order. The process is continuous and several orders may be going through the rollers at any one time.

2. The Nature and Skill Requirements of Changing Occupations

Furnace and strip mill operators will be required to place increased confidence in the accuracy and capability of automatic instruments and controls. The importance of craft skills and sensory judgments (sight observations and adjustments) will decline. This trend will result from the remote locations of control stations in new mills and the necessity of eliminating the margin of human error.

Mill journeymen grounded in instrument and control principles have been more willing to adjust to reliance on remote measurement devices than those who are unfamiliar with the instruments.

D. IMPLICATIONS FOR PROGRAM PLANNING

The new skills required by emerging and changing occupations include electronic, business, hydraulic, and metallurgical principles. High school orientation to these subjects will soon be considered a prerequisite for many entry jobs and apprenticeship candidates according to industry executives interviewed. These executives were concerned with the quality of vocational schools in the vicinity of their plants and recommended the inclusion of applied science courses in the high school curriculum.

THE HEALTH SERVICES INDUSTRY

A. GROWTH OF INDUSTRY EMPLOYMENT

A general order of magnitude for industry manpower requirements is established below by examining prior, current, and forecasted trends for each broad category of health manpower. The data is based on estimates of the demand for health services. Manpower productivity changes are of less importance here than elsewhere in this study because many of the occupations are so new that they are unlikely to experience any major changes in job content in the near future. Technological breakthroughs are mainly creating new positions and only a limited number of such breakthroughs are being applied to traditional hospital jobs.

1. Trained Health Manpower Requirements Will Double During the Next Decade

Each of the occupational groups shown in Exhibit 3, page 24, will continue to grow according to the trend established during the last decade. During that period, growth of specially trained personnel was over 100% while growth of other groups was a modest 15-25%. Each of these growth trends was considered somewhat conservative, according to an American Medical Association spokesman.

Health manpower requirements will continue to rise due to the professed desire of our society to minimize suffering from disease, the impact of Medicare, and the impact of rapidly rising personal income levels on health services expenditures (persons spend a greater portion of their income on health services as their total income rises).

In the manpower statistics and the occupational definitions of this chapter, the term technical applies to all occupations below the degree level that require specialized

Exhibit 3

TRENDS IN HEALTH MANPOWER DEMAND
(In Thousands of Persons)

	1955	1965	1975
Unskilled	460	530	500
Technically Trained	250	550	1,250
Diploma Nurses	420	530	500
Personnel with Degrees (other than doctors)	280	400	550
Physicians, Dentists, Veterinarians, etc.	340	430	500
Total	1,750	2,440	3,300

Source: Department of Health, Education and Welfare
Staff Papers of U.S. Public Health Service
Corplan Associates

training, except nursing. Technically trained personnel range from those needing only a modicum of specialized training--courses of a high school level--to those needing up to three years of specialized post-high school training. Technical jobs requiring a degree are included in the personnel with degrees category.

A major reason for the continued sharp expansion of supportive occupations in the face of much slower growth of other categories, such as physicians, is the trend toward utilizing subprofessional personnel to perform the routine portions of what has traditionally constituted the job of professional level personnel. This trend is exemplified by the expansion of such occupations as the physician's assistant, who takes blood pressure, prepares the patient for examination, and makes routine observation calls on patients; and the rehabilitation counselor, who aids the patient in adjusting to his physical condition. In addition, numerous laboratory and clinic employees perform work once done by the physician.

The use of mechanized and instrumented devices will expand as a result of their proven value. Personnel trained in the operation and maintenance of this equipment will be needed.

1. Current market projections for complex biomedical devices--defibrillators, kidney machines, spectrophotometers and the like--include growth rates ranging from 12-20% per year.
2. Current market projections for disposable biomedical devices show annual growth rates of nearly 20%, about half of which will result from increased hospital bed day demand.

2. Projections for Specific Occupations Are Becoming More Available

The Health Manpower Statistics branch of the USPHS has provided the data for the four occupations shown below. A national state-by-state, hospital-by-hospital inventory of current employees, shortages, and future requirements for 32 occupations is being conducted by that organization in cooperation with the American Hospital Association, and should be available by year-end.

	1955	1965	1975*
Registered Medical Technologists	18,000	35,500	70,000
Active Physical Therapists	7,300	12,000	20,000
Active Occupational Therapists	3,700	8,300	16,500
X-ray Technicians	47,000	70,000	100,000

*Estimated

Such data, broken down by state and including many additional occupations, will be available in the near future to vocational educators and should provide an excellent basis for program planning.

3. National Trends Can Probably Be Applied to Illinois

The foregoing national trends have been discussed under the assumption that they apply for the most part to Illinois.

Public Health Service data reveals that Illinois health statistics, such as number of hospital beds per 100,000 of population, number of physicians per 100,000 of population, and number of hospital personnel per 100 hospital beds, approximate nationwide averages. These facts support the above assumptions.

USPHS Health Manpower Statistics, under development as noted above, will be based on state-by-state building blocks and will serve to fill most information gaps on specific state health manpower trends.

B. EMERGING AND EXPANDING HEALTH SERVICE OCCUPATIONS

The impact of technology on the health service fields will result in a number of emerging occupations. Six of the most important are listed in Exhibit 4, page 28, and discussed below. Biomedical engineering--the use of electronic, mechanical, and nuclear devices to aid medical research, diagnosis, treatment, and care--has created a demand for personnel trained to set up, operate, modify, and maintain such equipment. These occupations have emerged during the last several years, and employment can generally be expected to grow significantly and steadily during the next decade.

Telemetry equipment operators constitute an exception; they are not expected to appear in significant numbers until about 1970.

Expanding occupations have been listed in two categories in Exhibit 4. Those included in the minimum training category generally require a high school diploma and, in some cases, up to 6 or 8 months of specialized preparation which may involve organized on-the-job training such as medical laboratory assistant.

Occupations listed under the technical category require from one to three years of special training, either in a junior college, college, hospital, or professional school, usually with the prerequisite of a high school diploma.

As noted in Section 1, a trend toward rapid expansion of technical occupations began in the past decade and is expected to continue during the next.

Exhibit 4

HEALTH SERVICE OCCUPATIONS

Emerging

Medical Engineering Technician
Electromedical Service Technician
Nuclear Medical Technologist
Medical Illustrator
Biomedical Telemetry Equipment Operator
Medical Record Assistant

Expanding

Technical

Medical Technologist
- Microbiology Technologist
- Serology Technologist
- Audiologist

Inhalation Therapist

Physical Therapist

Occupational Therapist

Radiology Technologist

Minimum Training

Medical Laboratory Assistant
Medical Secretary
Antiseptic Housekeeper
Female Nursing Aide
Male Nursing Aide
Ward Clerk
Surgical Technical Aide
Statistical Clerk
Laboratory Helper
Food Service Assistant
Occupational Therapy Assistant

1. The Nature and Skill Requirements of Emerging Occupations

More electronic and electromechanical devices, including x-ray machines, electrocardiographs, and diathermy equipment, are now being used. In addition, a new generation of devices are being installed, including H-L-R resuscitators (an oxygen-powered portable device to revive heart and lung action), spectrophotometers (an instrument for measuring the intensity of light transmitted through test solutions undergoing laboratory analysis), and ultrasonic machines (used for physical therapy).

a. Medical engineering technicians work closely with pathologists and medical research personnel to adapt and utilize biomedical devices in nonroutine situations, such as operations and laboratory research. These technicians require the equivalent of three years of electronics and premedical courses. They rely on electromedical service technicians to perform the more routine maintenance and set-up tasks. The service technicians receive one to two years of training in basic electronics, circuitry, pulse circuitry, and troubleshooting techniques. They require only a modicum of medical knowledge.

b. Biomedical telemetry equipment operators will monitor centralized telemetry equipment connected to remote locations, such as recovery rooms and research laboratories. Measurements of bodily functions--pulse, blood pressure, temperature--will be continuously observed, thus freeing nurses and doctors from such tasks. Continuous rather than periodic observation is thus provided.

c. Nuclear medical technologists prepare, administer, and measure radioactive isotopes in therapeutic, tracer, and diagnostic studies, using several radioisotope devices. They prepare radioactive solutions and adjust and calibrate equipment, such as geiger counters, scalers, and electroscopes. Specialized courses in radioactivity electronics and medical analytical techniques are given during the two-year post-high school course recommended for nuclear medical technology.

In addition to electronic aids, physicians and surgeons have a growing need for visual and data processing assistance. Medical illustrators graphically record data and surgical procedures. In large hospitals they may specialize in such subjects as anatomy, pathology, and embryology. Medical illustrators are frequently called display artists.

d. Medical record assistants help the medical record librarian in keeping complete and accurate records of medical history, laboratory findings, progress notes, and the like. Medical record assistants quality by completing a 9 to 12-month course in transcription and other medical record procedures. Such courses are currently offered by hospitals and junior colleges.

2. The Nature and Skill Requirements of Expanding Occupations

Medical technologists work directly under the supervision of a physician, helping him to carry out a variety of laboratory procedures and supervise laboratory assistants. For example, the technologist must be able to count blood cells, chemically test body fluids, prepare tissue specimens, operate biomedical devices, and perform numerous other tests. Larger hospitals have medical technologists who specialize in one technology, such as microbiology (bacteria) or serology(blood).

The minimum education needed to become a registered medical technologist is graduation from high school, followed by three years in college and one year in a training school approved by the Council on Medical Education of the American Medical Association. A high school background of chemistry, biology, algebra, and geometry is desirable.

Physical therapists prescribe and give treatments and exercises designed to strengthen muscles, regain muscle control and use of arms and legs, and overcome other disabilities. A knowledge of human anatomy and physiology and the use of prosthetic devices is gained during two to three years of college and in-service training.

Medical laboratory assistants perform the more routine duties formerly handled by medical technologists. From six to eight months of specialized preparation courses are approved by the Board of Certified Laboratory Assistants of the American Society of Clinical Pathologists.

Four minimum training occupations, female nursing aide, male nursing aide, ward clerk, and surgical technical aide, are described in detail in Exhibit 5, page 32.

C. IMPLICATIONS FOR PROGRAM PLANNING

Interviews with U.S. Public Health Service officials, two hospital administrators, and a hospital career counselor, and the numerical and descriptive data presented above identified implications for vocational and technical education program planning.

Exhibit 5

SELECTED JOB DESCRIPTIONS

1. Nursing Aide (may be male or female) works under the direction of a professional nurse, contributing directly to the welfare of patients. An aide may make beds, bathe patients, assist in feeding patients, deliver messages, escort patients to other departments, distribute diet trays, and perform other duties important to patient care. A male aide, sometimes called an orderly, may be asked to do the heavier work in a nursing unit, such as lifting patients, or moving and setting up large pieces of equipment.

   A nursing aide is trained on the job in a hospital, clinic, nursing home, or other health facility in a program consisting of up to three months of lecture-demonstrations and supervised practice. A high school education is preferred but not always required.

   Because an aide works directly with patients, an interest in people, a desire to be of service, and an ability to deal with people who are ill together with a sense of responsibility and attention to details are important employee characteristics.

2. The Ward Clerk, sometimes called a floor or station clerk, relieves the nurses of much paperwork, distributes records needed by physicians as they visit their patients, does general record keeping, and deals with certain aspects of the patients' charts. She also acts as a receptionist in the patient-care unit, directing visitors to the patients.

   A ward clerk is usually trained in an on-the-job program, averaging five weeks in length. She may be promoted from the nursing aide classification. She should be a high school graduate, preferably with some clerical training, be able to spell and do arithmetic accurately, and be able to type. She must have a pleasing personality and a gracious manner.

3. A Surgical Technical Aide works under the direction of a professional nurse, caring for patients in hospital operating rooms or delivery rooms, assisting in the care, preparation, maintenance and use of supplies and equipment, and working as a member of the surgical team during surgery.

   A stable temperament and ability to work under pressure are important for a surgical technical aide, as well as a keen sense of responsibility, great attention to detail, and concern for accuracy. The aide must be sensitive to the needs of the patient and the members of the surgical team. Manual skill and dexterity, along with physical stamina, are important.

   A minimum high school education or its equivalent is needed to become a surgical technical aide. Training consists of from four to six months of classroom instruction and supervised practice.

Source: American Hospital Association

1. New Sources of Manpower Supply Will Be Required To Meet Future Demand

Existing in-hospital, secondary school, and post-secondary school programs preparing persons for health service occupations will be unable to meet needs for trained manpower over the next decade.

Hospitals, hospital administrators, and others involved in health career planning have a significant and increasing interest in cooperating with vocational educators to develop programs involving (1) pre-occupational health orientation courses in secondary schools, (2) adult education courses in local high schools to supplement in-service training programs, and (3) technical education programs in technical institutes and junior and community colleges.

2. Secondary School Courses in the Health Field Could Satisfy Two Needs

Secondary school courses in the health field would prepare students for entry jobs available to high school graduates and would provide a foundation for students entering associate, technical, and regular post-high school programs offering a degree. Such programs could include survey courses in basic anatomy and physiology, medical terminology, and applied laboratory courses in chemistry.

Entry jobs available to high school graduates with credits in the above courses include those of medical secretary, statistical clerk, and surgical technical aide.

The base core could provide a valuable foundation to those aspiring to technical occupations such as microbiological technologist or inhalation therapist. It could shorten the length of in-hospital training classwork and increase the effectiveness and level of specialized one or two-year technology programs in junior colleges or technical institutes.

3. Jobs Exist for Adults Trained in Evening School Programs

To satisfy the demand for minimum training occupations discussed above, adults with or without high school diplomas could be trained in evening courses at local high schools, community colleges, and junior colleges. Such courses would be likely to attract former high school dropouts because they would be billed as technical or vocational rather than high school courses, and would lead directly to available entry jobs.

Course offerings might include medical terminology, laboratory training, and communications.

4. A Lack of Articulation Is Evident in Existing Training Programs

Training programs generally lead to a specific position which may involve a minimum or a high degree of technology. Few, if any, courses are offered to the qualified student who wishes to upgrade his technical qualifications. Examples of such upgrading include the certified laboratory assistant who aspires to be a medical technologist and the practical nurse who aspires to be a registered nurse.

This lack of career flexibility discourages youth and adults from entering health careers. Health occupation education should articulate secondary and post-secondary training with evening school, MDTA, and in-hospital programs designed to upgrade the abilities of those currently or previously employed in health service occupations. At present there is no ladder concept which allows easy exit and re-entry to a training for progressively higher level occupations.

THE PRINTING AND PUBLISHING INDUSTRY

A. GROWTH AND DISPERSION OF INDUSTRY EMPLOYMENT

As discussed in the chapter on methodology, the establishment of a general order of magnitude for industry manpower requirements requires an examination of national sales and manpower productivity trends, their applicability to Illinois, and an evaluation of industry dispersion and operational differences between the Chicago Metropolitan Area and Downstate.

1. The Net Effect of Projected Sales Increases and Productivity Gains Will Be a Moderate Increase in Industry Employment

National printing and publishing sales and productivity forecasts made by Corplan[1] two years ago have been updated and applied to Illinois. The base year used is 1963[2], the latest year for which complete Census of Manufactures data is available, and the terminal year is 1980, chosen because of its coincidence with productivity projection data.

a. Sales increases. The Corplan study mentioned above forecast an annual industry growth rate of between 4-5% over a 17-year, 1963-80 period. Total growth on a compounded basis amounts to between 90 and 112% over that period.

For the purpose of this study, the Corplan team has developed a current projection based upon the Federal Reserve Board printing index, an index of forecast printing and publishing industry production. This index shows a rise from the 1965 index number of 130 to 225 by 1980, a compounded growth rate of slightly more than 4%. The index growth rate for the 1965-80 period is higher than that of the preceding decade, reflecting increases in the nation's reading commensurate with a higher standard of living and increasing leisure time.

Sectors of the industry such as textbook printing and publishing should experience growth rates slightly in excess of the current 10%[3] rate, thus offsetting more slowly growing sectors such as periodicals (where the percentage increase in advertising expenditures has only recently come close to matching that of the gross national product) and commercial printing (Illinois firms like E. F. Hall and R. R. Donnelley do a great portion of their business in catalogs and directories, publications whose size is largely dependent upon advertising expenditures). The major cause of the limited growth of periodical advertising revenues has been television competition.

Computing an average, weighted according to value added, of industry sector growth rates, including rates ranging from approximately 10% for smaller sectors to less than 3% for larger sectors, yields a composite rate of 5%.

In view of the three forecasts mentioned above

- The previous Corplan study
- The Federal Reserve Board printing index
- The weighted average of sector projections

an industry compounded growth rate range of 4-5% per year will be used in this study.

GNP, according to U.S. Department of Labor and U.S. Department of Commerce projections is expected to rise from a 1963 level of $589 billion to a 1980 level of $1100 to $1300 billion, a compounded growth rate of between 4 and 4.5% over the 17-year period.

Growth of GNP and the printing and publishing industry are therefore forecast to be approximately the same--in previous years the former has been somewhat higher.

b. Productivity gains. Estimates of manpower productivity increases likely to be engendered by technological changes in the production functions of the industry were made with cognizance of the weighted impact of innovations such as

1. Computer hyphenation and line justification
2. Phototypesetting
3. Synthetic plates
4. Semiautomated high-speed presses
5. Perfect binding and ultrasonic paper welding
6. Faster finishing machines and automated materials handling

Percentage increases of individual productivity functions (each of the functions is discussed in the following section) are shown below; the weighted average gain amounts to nearly 75%, a compounded rate of 3.5% per annum.

	% of Production Employment	Estimated Productivity Gain 1963-1980
Preparatory Operations	20-30	80%
Press Operations	35-45	80%
Finishing Operations	25-35	60%

Two prominent union officials and one industry association executive were interviewed to determine the extent to which union attitudes and activities might affect manpower productivity increases. Each of the interviewees felt that unions had a positive attitude toward all innovations short of total automation.

Electrostatic and electronic printing innovations, considered to be total automation by union officials, are not likely to have a significant impact in Illinois until the late 70s due to the major improvements in quality that must be made (such as keeping clear areas clean). Quality is extremely important in periodicals and book printing, the two sectors where electronic printing is most likely to have an impact.

c. Production employment. In Exhibit 6, page 41, the net effect of national sales and productivity growth rates is shown. Employment of 10-25% additional workers is estimated based on sales growth rates ranging from 4-5%. These figures represent additional workers needed, not replacements for retiring or displaced workers.

d. Nonproduction employment. Nonproduction employees in the state numbered 35,000 according to 1963 Census of Manufactures data. Within their ranks technical and administrative jobs can be expected to expand by virtue of the technical setup and maintenance requirements of future printing and composing equipment; white-collar jobs will expand in conjunction with computer installations (changes in office industry occupations will be discussed in detail in the chapter devoted to those occupations).

Exhibit 6

1963 AND 1980 ESTIMATED PRODUCTION EMPLOYMENT IN THE ILLINOIS PRINTING AND PUBLISHING INDUSTRY

	1963	1980*	% Increase
4% Growth Rate	62,000	68,200	10
5% Growth Rate	62,000	77,500	25

*1980 estimates include the offsetting effect of a 3.5% per year productivity gain.

Source: 1963 Census of Manufactures
Corplan Associates
IIT Research Institute

An information gap exists as to the magnitude of additional employees needed; according to the rapid growth of nonproduction employment in other industries, we would expect a growth rate (after consideration of productivity gains) greater than those shown for production workers in Exhibit 6. Nonproduction workers would therefore comprise a greater portion of the industry work force in the future.

2. National Sales and Productivity Trends Can Probably Be Applied to Illinois; Additional Information Needs To Be Developed

In the foregoing projections, national trends were applied to the State of Illinois assuming that the Illinois industry is substantially similar to that of the nation. The significant amount of activity of Illinois printing and publishing in each major subdivision of that industry--newspapers, periodicals, books, textbooks, commercial printing, and business forms--and the relatively constant percentage of nationwide output produced in Illinois supports that assumption. Growth in Illinois is anticipated for the same reasons as elsewhere: a growing demand for educational materials, more leisure reading and hence increased demand for periodicals and paperbacks, and growing markets for commercial printing products and business forms.

Detailed information on the composition and dynamics of each Illinois printing and publishing industry sector would be useful in discovering the specific sales and productivity trends in the state.

3. Technological Changes Affecting Firms in the Chicago Area Will Apply to Those Downstate; Some Chicago Firms Are Likely To Relocate in Suburban or Downstate Communities

Approximately 90%[4] of statewide printing and publishing employment and output is concentrated in the Chicago Metropolitan Area. Downstate shops tend to be smaller and have a higher ratio of production to total employees.

Most of the technological changes affecting the industry will apply to downstate firms despite their smaller size. There will be a trend toward merger and consolidation into larger shops and the establishment of service center corporations providing composing (preparatory operations) room services to the individual firms within a surrounding area.

These larger firms will be able to make large expenditures for high-speed presses. The service centers will operate on a scale allowing the economical use of such devices as computers and Linofilm machines.

A limited number of Chicago area firms are likely to circumvent the problems of high labor costs, organized labor, or obsolete facilities (loft buildings) by relocating a part or all of their operations to outlying or downstate communities. Some of this mobility may extend to nearby states, as exemplified by the recent construction of an R. R. Donnelley plant in southern Indiana at Crawfordsville.

B. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

The three most important functions in the printing and publishing industry, which account for over 95% of production employment, are the preparatory operations, where copy is processed into chases and plates; the printing press operations, where the actual printing is performed; and the finishing operations, where the printed material is assembled and processed into the finished product.

Emerging, expanding, and declining occupations resulting from technological developments are discussed within the framework of these three groups. Exhibit 7, page 45, lists the titles of those occupations, most of which will be discussed in detail in the paragraphs to follow. Except as specifically noted, these occupational changes began in the mid-sixties or before and are expected to occur continuously throughout the next decade.

1. Phototypesetting and the Trend Toward Color Work Will Cause the Major Occupational Changes in the Preparatory Operations

Phototypesetting, the process that puts copy (writing in its final form) on film, was introduced during the last decade in response to the development of offset and web offset printing. During the next decade the growth of offset printing relative to letterpress printing and the development of advanced phototypesetting techniques will create expanding and emerging occupations.

Phototypesetters operating machines such as Fotosetter will replace linotype operators in proportion to the increased percentage of total printing that will be done by offset techniques (the magnitude of this percentage is discussed in the section on pressroom operations). The relationship is approximate since some linotype machines can be efficiently adapted to offset operations through the use of reproduction proofs. Skill requirements will rise moderately in the form of increased alertness and manual dexterity necessary to cope with the faster and more versatile phototypesetting machines. A knowledge of darkroom techniques will be necessary since the machine operator is required to develop the film produced.

Exhibit 7

PRINTING AND PUBLISHING OCCUPATIONS

Emerging

Electronic Color Separator Operator

Electronic Composing Equipment Maintenance Technician

Electronic Phototypesetter Operator

Linofilm Machine Operator

Photon Machine Operator

Press Maintenance Technician

Expanding

Color Separation Cameraman

Fotosetter Machine Operator

Offset Press Operator

Stripper

Web Offset Press Operator

Declining

Binder

Cutter

Electrotyper

Handler

Imposer

Letterpress Operator

Linotype Operator

Stereotyper

Stitcher

Tipper

Electronic phototypesetting developments will have an impact on only one-half of the potential phototypesetting jobs mentioned above.[5] During the next decade both phototypesetters and linotype operators will be displaced by electronic phototypesetters operating Linofilm and Photon machines.

Photon and Linofilm machine operators will need knowledge in such diverse fields as optics, electronics, imposition and layout, and darkroom techniques. Since electronic circuitry and servomechanisms will be the heart of these machines, a knowledge of basic electricity and electronics is essential for the identification and prevention of routine breakdowns.

Optical principles govern the magnification and reduction of standard font sizes available to Photon and Linofilm machine console operators. The material on images and focal lengths usually taught in high school physics courses would probably provide an adequate background. Column, margin, and layout decisions will have to be made quickly and not on a trial and error basis, hence more problem-solving ability will be required.

Employment of imposers will be reduced by advanced electronic photocomposition machines which perform the imposing function. Imposing is the step during which film strips or other materials are physically arranged into their final position ready for manufacturing printing plates.

Electronic composing equipment maintenance technicians will require an extensive background in electronic circuitry and the operation of servomechanisms. The courses and time required to train such people will be noted in the section on vocational training methods and in the chapter on the electronics and electrical equipment industry.

Color separation occupations will expand and emerge because of the increasing industrywide demand for color work in textbooks, newspapers, and periodicals. Color separation cameramen will constitute a rapidly expanding occupation in the decade ahead. The occupation requires basic camerawork skills, knowledge of the light spectrum, and other technical matters.

The electronic color separation machine operator is an emerging occupation with skill and discipline (the knowledge of and ability to follow fixed rules and procedures) requirements analogous to those of other operators of electronic printing and publishing equipment. The timing and magnitude of the impact of electronic color separation is difficult to predict even though units such as the German-made Consolidated Klischograph have been in operation for several years. Significant employment in this occupation probably will not occur until the early 70s due to the necessity of improving the color correction of present equipment. At that time some displacement of color separation cameramen and allied workers such as dotters and filmmen is likely to occur.

Employment of platemakers will level off or decline due to drastic reductions in plate processing time resulting from the use of plastic plates, like DuPont Dycril, powderless thin etch metal plates, and synthetic lined gravure plates. Reductions in hand work such as etching are likely to lower the general skill level requirements of platemakers.

2. Occupations in the Pressroom Will Change as a Result of the Trend Toward Offset Printing and the Increasing Complexity of Offset Presses

Printing is performed by direct and offset printing processes. The two major direct processes are letterpress and gravure; the latter is used mainly for quality color work in periodicals and catalogs, and the former is used for newspapers and books. Offset printing may be done on sheets of paper or on a web or continuous strip of paper.

The speed of offset presses, especially the web type, and the advantages over letterpress in color work performance have produced an important trend toward offset printing. During the past five years offset grew 30% while letterpress declined 15%. This trend should continue.

Offset and web offset press operator positions will therefore expand, displacing some letterpress operators. Instrumentation advances and the use of higher degree of precision in ink and paper selection will continue to increase the skill requirements of offset press operators. A background in industrial chemistry, instrumentation and control, and electronics will become increasingly useful.

Printing press maintenance technicians will emerge, an occupation requiring a post-high school level knowledge of electronics and instrumentation and control.

3. Certain Skilled Occupations in Finishing Operations Are Likely To Become Semiskilled; Occupations of Some Semiskilled and Unskilled Workers Are Likely To Be Displaced

During the next decade, faster semiautomatic or automatic machines will be used in finishing operations. The types of finishing work vary widely depending on the type of finished printed product. Examples of finishing operations are collating paper; interleaving paper and carbon paper; folding paper, drilling or punching holes in paper; binding paper into products such as books, catalogs, telephone directories, and magazines; and trimming and stacking paper.

Automatic stitching and binding machines will reduce the skill requirements of stitchers and binders. Perfect binding (adhesive-stitchless binding) will speed up the binding process.

Improved paper handling capabilities by electronic and mechanical devices will eliminate many of the handler and helper jobs now in existence, while concurrently creating maintenance technicians jobs requiring electromechanical skills.

Technological change in the production function of the printing and publishing industry will therefore have a considerable impact on the subprofessional jobs now in existence and will create new occupations for preparatory and press operations.

Skilled employees will hold a nearly constant portion of industry jobs in the face of changing skill requirements, although, as noted above, the required level of some occupations will drop. Semiskilled and unskilled jobs will suffer most from technological change and automation. Estimates made in the previous Corplan study specify that semiskilled workers and unskilled workers as a percentage of the labor force will drop from 34 to less than 30 during the 1963-80 period.

C. IMPLICATIONS FOR PROGRAM DEVELOPMENT AND FACILITIES PLANNING

The technological evolution of the printing and publishing industry will raise both the basic and vocational education requirements of entry, journeymen, and technical occupations and will greatly increase the cost of graphic arts laboratories.

Preceding occupational descriptions identified mathematics, physics, chemistry, and electronics as basic skills which will become important tools of future industry tradesmen and technicians.

If vocational education is to produce qualified manpower for such occupations, students will need applied science and technology courses at the high school and post-high school level (i.e., in junior college programs and curricula such as the Printing Technology Associate degree program offered at the Vocational-Technical Institute at Carbondale).

Implications for vocational and technical education planning may be drawn from union and nonunion training facilities established primarily to retrain journeymen, a group with an average age of nearly 50 (average retirement age is 62). The Printing Industry of Illinois, an association of nonunion printers, has established the Chicago School of Printing and Lithography that offers courses in color separation and offset presswork, among others.

The International Typographical Union has a graphic arts training center at Colorado Springs, Colorado, with an investment of over $1 million in land and buildings and another million dollars in equipment. About 500 men a year are retrained in a series of three to six-week courses. The high cost of modern equipment is exemplified by an investment of $50,000 in a Linofilm machine and over $200,000 in a Fairchild Color-King four-unit perfecting web-fed offset press. Electronic composing equipment maintenance technicians are trained in a six-week course which is open to only those students who have had previous electronic and electricity training and who pass a written examination. The cost of graphic arts laboratories may well justify the establishment of one or two specialized schools for the entire state.

Several information gaps should be filled before decisions regarding the future role of vocational and technical education in graphic arts education are made.

To aid vocational educators in answering these questions

- What courses should be offered?
- In which geographic areas should courses be offered?
- Should area schools, junior colleges, or local schools be used?
- At what level should the courses be taught?
- When should courses be developed and offered?

the preceding information has been developed. Additionally, the following information should be developed.

- Data on the number of replacements required by the several industry sectors on a regional and statewide basis. The purpose of developing such data is to determine whether retraining of adult workers or the training of youth will be more important (as noted above, the average age of industry journeymen is nearly 50; hence, training of youth should be an important factor) and to develop data to supplement estimated additions to the labor force as the basis for manpower planning. An inventory of current employment by occupation would provide a basis for this data.
- Additional, more specific data is needed on the technical and problem-solving skill content of industry jobs both emerging and expanding. Such information will provide a basis for course selection and curriculum development and clarify the role of vocational and technical education in the overall education process.
- Data on manpower productivity of nonproduction workers would provide a more definitive basis for manpower projections, especially in technical occupations.
- Information on individual sectors of the industry in Illinois would provide a basis for sales projections made independently of national figures; a geographic survey would aid in the location of area and local classroom and laboratory facilities.

THE ELECTRONICS AND ELECTRICAL EQUIPMENT INDUSTRY

A. ABSTRACT AND INTRODUCTION

The past, present, and future of the electronics and electrical industry has been, is, and will be keyed to advances in technology to an extent found in few other industries. The impact of technology will create many new occupations and change the skill requirements of still others. Sales and value added will rise at a substantially faster rate than manpower productivity causing increases in the total labor force.

Information on the nature of expected occupational changes is available and is presented in this section. Projected additions to the labor force have been identified but an information gap exists as to the number of replacement requirements. Newer technologies can be expected to have employees with a younger average age.

Four major implications for program planning have been shown:

- Minimum technology electronics jobs require less than one year of post-high school training if an adequate high school background is provided.
- A core electronics orientation permits trainees to enter nearly any type of on-the-job training.
- Employers feel that the private technical institutes are becoming less sensitive to their needs.
- Present electronics technicians lack communications skills.

B. GROWTH OF INDUSTRY EMPLOYMENT

During the next decade, industry sales and value added is likely to rise at a 6% rate compared to productivity gains of from 2.5% to 3%. In 1965, Illinois ranked second among all states with an estimated total employment of over 170,000. Based on an annual rise of 3.5%, employment in 1975 is estimated to be nearly 225,000.

Regional vocational education facility planning decisions must take cognizance of the substantial differences among the growth rates of major industry sectors. For sales and value added, the following national growth rates apply to important industry sectors in Illinois.

Industrial Control Electronics	10-12% per year
Consumer Electronics	5- 7% per year
Consumer Electrical Appliances	3% per year

Industry manpower demand would be expected to grow faster in a county or region with a plant manufacturing industrial controls or television sets than in one with a clothes washer or refrigerator plant.

According to a previous Corplan study, national figures may be applied to Illinois except where the military electronics sector is concerned.

C. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

The most significant impact of the changing electronics industry will be on technical jobs; to a lesser extent skilled and semiskilled jobs will also be affected. Three segments of the Illinois electronics and electrical equipment industry--consumer electronics products, industrial instrumentation and control, and telephone equipment--account for over 85% of the industry's employment. Occupations within these sectors will be influenced by numerous technological changes, the most important of which are the following:

- Industrial control electronics
- Microelectronic devices and circuitry
- Electronic telephone transceivers and switchboards

Emerging, expanding, and changing occupations discussed below are placed in three skill requirement categories. The differences between those categories will be explained in Section D of this chapter.

It is within the framework of the skill levels, industry sectors, and technological changes noted above that specific occupations are discussed and sample job descriptions are presented. Exhibit 8, page 55, lists emerging, expanding, and changing occupations by skill level, many of which are discussed below.

1. Rapidly Expanding Use of Electronic Instrumentation and Control Devices in Nearly All Manufacturing Industries Will Cause Occupations To Emerge, Expand, and Change in Instrument Manufacturing Plants and User Plants

Electronic instrumentation and control devices activate, control, monitor, and sample mechanical and process operations in such diverse fields as chemical processing, machining, printing, and medicine.

Electronic systems technicians (Skill Level 3) design and develop devices for custom, limited, and mass production applications to customers' needs. Prototype models are constructed and tested on the basis of schematic diagrams and engineering specifications developed by professional personnel. Judgment is often used in determining the circuitry and components needed to meet specifications. This occupation is emerging as a result of the proliferation of custom applications of electronic control devices.

Electronic instrumentation technicians (Skill Level 3) will supervise and develop production techniques within instrumentation and control manufacturing plants.

Exhibit 8

ELECTRONIC AND ELECTRICAL EQUIPMENT INDUSTRY OCCUPATIONS

Advance Technology (Skill Level 3)

Electronic Systems Technician
Electronic Instrumentation Technician
Electromedical Laboratory Technician
Microelectronics Research Technician
Electromechanical Technologist

Technical (Skill Level 2)

Electromedical Service Technician
Graphic Arts Maintenance Technician
Electronic Switchgear Technician
Printed Circuit Design Technician
Electrical Design Draftsman
Electromechanical Maintenance Technician

Minimum Training (Skill Level 1)

Consumer Electronics Tester and Inspector
Communications Equipment Tester and Inspector
Test Technician Fractional Horsepower Motors
Consumer Electronics Service Technician
Component Assemblers
Precision Assemblers
Maintenance Electricians

Electronic instrumentation and control testers and inspectors (Skill Level 2) troubleshoot and make final adjustments on completed devices. Their work requires a knowledge of the circuitry and structure of both the devices and basic test instruments such as the oscilloscope and frequency analyzers; knowledge of components and design theory is not necessary.

Occupations will emerge and expand in the businesses and institutions which use electronic instruments. Hospitals and medical research laboratories are good examples of such institutions. Electromedical laboratory technicians (Skill Level 3) will adapt electronic equipment to the special needs of particular medical research projects. Electromedical service technicians (Skill Level 2) will be required to adjust and repair equipment such as the electrocardiograph, phonocardiograph, and x-ray machine. Maintenance procedures similar to those presently used in radio and television servicing will be required.

Electronic graphic arts equipment maintenance technicians (Skill Level 2) represent a hybrid occupation requiring thorough grounding in electronic circuitry and servomechanisms and a knowledge of composing and pressroom operations and equipment. These technicians will be employed by composing shops, commercial printers, book printers, and other establishments in the printing and publishing industry.

Growth of employment in the above occupations will be continuous, relatively constant, and approximately proportionate to the anticipated growth of instrumentation and control device sales and output (13-17% per annum).

2. Two Generations of Microelectronic (Integrated Circuit) Devices Will Cause Occupational Skill Requirements To Change in Production Line and Technical Jobs; A Third Generation Will Have No Significant Impact Until 1980

A major change in the design and production of nearly all electronic devices is presently underway. Its impact is only beginning to be felt by the industry--in the next five to ten years, extensive repercussions are likely. Electronic components (tubes, transistors, capacitors, etc.) are presently the basic building blocks of the electronics industry. These are assembled into electronic circuits which in turn become parts of electronic equipment such as transceivers, radios, and television sets. Recently, a new approach has emerged--a circuit-oriented design. In this method, the electronic circuit itself becomes the basic component. The integrated circuit is a solid-state device which combines the functions of one or more components into a single higher order component.

The first two generations of such high order components--high-density packaging and thin-film techniques--will affect the skill content and growth of the occupations discussed below. The third, molecular electronics (molecular electronic devices consist of materials whose inherent electrical properties are used to perform component and circuit functions) will not be generally accepted for consumer product use until 1980 or beyond.

The Illinois electronics industry, which is heavily concentrated in consumer end-product production--radio, television, tape recorders, etc., will undergo changes in assembly techniques used to manufacture equipment from the new types of components and circuits. Inspection and maintenance skills and procedures will change commensurate with changes in components, circuits, and assembly techniques.

Microelectronic research technicians (Skill Level 3) construct prototype electronic equipment and systems based on designs produced by electronics engineers. They exercise considerable discretion in the selection of circuits and subsystems.

Television, radio, transceiver, and photograph systems produced from integrated circuits and other high order components receive a limited number of tests and quality checks during assembly. This necessitates a thorough technical testing and inspecting when assembly is completed. Testers and inspectors who perform these final checks require training similar to radio and television servicemen. They can be trained in six to eight months, if an adequate high school background was provided and are classified in Exhibit 9, page 59, as Skill Level 1.

3. Electronic Telephone Equipment Will Require Electronic Maintenance Techniques

Electronic telephone switchgear technicians (Skill Level 2) will apply electronics repair procedures in place of most prior electromechanical procedures since telephone switchgear and transceiver sets are being converted from mechanical to electronic components.

D. IMPLICATIONS FOR PROGRAM PLANNING

Four major implications have been drawn, two of which obtain from an evaluation of the training prerequisites for technical positions and two of which are employers' opinions of existing electronics programs and their graduates.

The three skill levels used to classify industry occupations are based primarily on formal training requirements. Skill Level 3 occupations require two to three years of intensive post-high school training. Levels 2 and 1 require one to two years, and six months to one year, respectively, depending on the intensity of the subject matter.

Electronics maintenance and technical skills comprise a major portion of jobs in many industries. A core electronics orientation would permit trainees to enter nearly any type of on-the-job training leading to technical and journeymen qualifications. The orientation should include electrical principles, basic circuitry, and component functions (rectification, amplification, resistance, capacitance, etc.).

Minimum technology electronics jobs, such as equipment testers and inspectors, require less than one year of intensive post-high school training if an adequate high school background is obtained. Six to eight months in-plant programs for these positions are now being conducted, but employers deem them an inadequate long-run employment source.

Employers criticized private technical institutes for being insensitive to their needs and for failing to offer effective communications and English courses. Courses tend to train too many for Skill Level 2 jobs and too few for minimum technology jobs.

THE AGRIBUSINESS INDUSTRY

A. ABSTRACT AND INTRODUCTION

Employment in off-farm occupations will increase over the next decade in the face of declines in on-farm employment. Many farm youth can therefore be channeled into vocational education courses preparing them for agricultural service and supply jobs. These farm-related occupations have core course requirements similar to occupations in other industries.

B. GROWTH OF INDUSTRY EMPLOYMENT

Off-farm employment will increase during the next decade. U.S. Department of Agriculture projections call for an annual increase of from 1 to 5% depending on the nature of the occupation. Available data is unfortunately inadequate in terms of predicting ranges of Illinois employment growth.

In contrast to the off-farm manpower growth, current U.S. Department of Labor projections call for a decline in on-farm employment of 2 to 2.5% per year over the next decade. This decline indicates the need to provide farm-related occupational training for those with a farm background. In the opinion of interviewees, farm-related jobs can be best performed by persons who have grown up on the farm or have had farm experience.

During the study an information gap as to the magnitude of manpower requirements for specific farm-related occupations was noted. In order to establish the feasibility of projections of this type, the following information was developed for Agricultural Implement and Tractor Mechanics:

> The number of implement and tractor dealerships in the state (nearly 1000 including Ford, Deere, Case, Harvester, Oliver, and Massey-Ferguson)

- The average number of mechanics per dealership
- Retirement data including estimates of the average age of these mechanics
- Current forecasts of agricultural machinery industry growth (4-5% per annum)

From this data a growth rate for occupational employment of nearly 8% per year has been forecast (400 new mechanics per year) for the next five to ten years. This high growth potential is attributable to the growth in number of machines to be serviced, the increasing popularity of dealership service, and the high average age of current journeymen mechanics.

From the above data, estimates of the future supply (in-dealership training, newly established post-secondary curricula, and other vocational education programs) should be deducted in order to determine future labor shortages. Interviewees taking cognizance of the above forecast were unanimous in their feeling that the demand would far exceed current and anticipated sources of supply.

C. THE NATURE OF FARM-RELATED OCCUPATIONS

Farm-related occupations fall into four major categories--the production, sale, delivery of farm supplies, and the field technical services. Several trends have been established which have expanded the number of persons employed in occupations related to those four categories.

First, the farmer spends more time on the farm and desires to have feeds, seeds, hardware, fertilizer, and petroleum delivered. Second, scientific farming has increased the use of fertilizers, feeds, and other supplies, and third, farmers use more assistance in selecting and operating complex systems such as dairy and harvesting equipment.

Interviews with agricultural chemical companies, feed and seed manufacturers, farm service companies, and the Illinois Agricultural Association identified a substantial number of farm-related occupations, a sample of which is listed in Exhibit 9, page 63.

An example of a changing occupation is the field dairy technician whose major role has been to discuss methods for improving milk production, to test milk for butterfat content and sediment, but now concentrates on such things as bacteriological and toxicity control checks. He usually represents a milk company with which the farmer holds a long-term purchase contract.

D. IMPLICATIONS FOR PROGRAM PLANNING

Foundation course requirements for farm-related occupations are common to those of a number of occupations in other industries. These commonalities suggest a possible trend away from specialized vocational agriculture courses. An indication of the importance of increasing course offerings in these areas is given by the recruiting of employees from other states by Illinois farm service and agricultural firms.

The four foundation courses important in providing background skills and orientation for those entering farm-related jobs are

- Fundamentals of applied chemistry (including bacteriology and microbiology)
- Hydraulic and mechanical technology
- Instrumentation and control electronics
- Communications and practical English courses

Exhibit 9

FARM-RELATED OCCUPATIONS

Technical

Field Technician--Dairy
Field Technician--Crop Treatment
Field Technician--Agricultural Chemicals
Agricultural Implement and Tractor Mechanic

Sales

Feed and Seed Salesman
Agricultural Chemical Salesman
Petroleum and TBA Salesman
General Line Salesman

Other

- Farm Service Company Personnel
  - Mixer
  - Loader
  - Local Elevator Manager
  - Route Deliveryman
  - Headquarters Office Staff
- Livestock Buyer
- Farm Machinery Setup Man
- Farm Checker

A core course in applied chemistry would provide skills for the field dairy technician as well as those entering health services and chemical process industry occupations.

Hydraulic and mechanical technology skills of agricultural implement mechanics are similar to those required by millwrights, electromechanical technologists, and all other occupations related to maintenance and repair of modern equipment.

Communications skills, business letter writing, and principles of accounting are the most frequent business skills required by field salesmen and service bureau operators. These skills may be taught in conjunction with practical English courses offered to all vocational education majors.

THE FOOD PROCESSING INDUSTRY

A. ABSTRACT AND INTRODUCTION

During the next decade food processing industry sales and productivity increases will be modest. On a selective basis industry sectors such as frozen and convenience foods will grow at a far faster rate than the average.

Over 75% of the Illinois food processing industry technical and production employment is within four sectors:

- Meat products
- Bakery goods
- Canned and frozen foods
- Dairy products

The proliferation of pre-prepared and convenience foods will expand occupations concerned with recipe formulation and food preparation. A second trend is to install instrumentation and control devices for the processing of bakery goods and specialty meats.

In common with other industries studied, chemical and electronics principles are important prerequisites for emerging, expanding, and changing occupations.

B. GROWTH OF INDUSTRY EMPLOYMENT

Food industry sales growth is closely tied to population trends and historically has been of moderate proportions. A search of industry and Department of Agriculture publications revealed several studies on manpower productivity trends but no definitive data useful for meaningful forecasting. A moderate growth in manpower productivity will be assumed since such a trend has accompanied mechanization and automation in other industries using instrumentation and control devices.

Several industry sales forecast sources including

- *Predicasts*
- Industry economists
- Supermarket Institute

were evaluated revealing an expected growth of between 3.5% and 4.5% per year for the next decade. Offsetting productivity growth of 2% per year would limit total manpower increases to modest proportions along the lines of the printing and publishing sector.

C. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

Four parts of the Food and Kindred Products Industry (SIC Code 20) comprise nearly 60% of the industry's employment in Illinois. These parts--meat products, bakery products, canned and frozen foods, and dairy products--employ over 75% of the technical and production workers. Both individually and collectively these four parts are experiencing and will continue to experience technological changes which will create new occupations, increase the demand for others and change still others. Other parts of the industry including beverages and grain mill products are not likely to experience as much technological change. Exhibit 10, page 67, lists the occupations in point, many of which are discussed below.

The occupational data here presented relates almost exclusively to jobs and job categories within the processing plants of the industry. Jobs and occupations at the retail level (for example, supermarket clerks) are not discussed since they are generally considered to be part of the Retail Trade Industries (SIC Codes 52, 53, and 54).

Exhibit 10

THE FOOD PROCESSING INDUSTRY

Meat Products

Commercial Home Economist
Construction Technologist
Maintenance Electrician
Maintenance Mechanic
Hide Puller
Splitter
Butcher

Bakery Goods

Specialty Baker
Quality Control Technician
Quality Control Assistant
Chemical Technician

Canned Frozen Foods

Commercial Home Economist
Refrigeration Maintenance Technician
Pressure Chamber Operator
Freezing Equipment Maintenance Technician
Quality Control Assistant

Dairy Products

Microbiological Quality Control Technician
Instrumentation and Control Technician
Route Salesman
Quality Control Assistant

1. Mechanization of Processing and Added Convenience Foods Will Cause the Significant Occupational Changes in the Meat Products Company Plants

Historically the processing of beef, pork, lamb, and other meats consisted of a number of discrete steps--slaughtering, skinning, hide pulling, splitting, boning, and final cutting and trimming--each performed by a skilled craftsman using hooks, knives, saws, and relatively simple mechanical aids. Recently semiautomatic and automated equipment has been utilized, but retention of the basic process is expected. In common with a number of other industrial sectors discussed in this study, a demand has been created for several categories and levels of technicians.

Electronic instrumentation and control maintenance technicians (*see Skill Level 3 occupations*--Electronics and Electrical Equipment chapter) will be required to service automated equipment for meat processing lines and margarine mills. Manpower demand for maintenance mechanics and maintenance electricians will be expanding as a result of the increasing numbers of linking, hide pulling, and trimming machines to be installed and serviced during the next five years. Servicing and maintaining such machines requires the skill of an electrician or mechanical maintenance journeyman. High school courses in basic circuitry, electrical equipment and controls, and mechanical adjustments would enable persons to perform well in such jobs after one to two years of experience.

Construction technologists are emerging as an occupation brought about by the general trend toward subdividing engineering occupations to allow persons with less than a baccalaureate degree of education to perform many of the more routine, repetitive, but nevertheless technical, functions. The continuing trend toward packing plant modernization has created an excess demand for civil engineers and plant layout designers. Several of the largest meatpackers (two of whom were interviewed) have projected the construction or complete modernization of at least one facility per year over the next decade. A two or three-year post-high school program covering structural design, applied mechanics, plant layout, and mathematics up to and including a year of calculus would provide the courses necessary to prepare youth for such positions.

A number of occupations will change as a result of technological change. Skinners, hide pullers and splitters, trimmers, and linkers will experience a decline in skill requirements as machinery is introduced. Dexterity with hooks, knives, and clamps will become less important since these functions will be performed by machine.

Convenience and pre-prepared food product growth trends will affect meat sales substantially. Seasoned, partly or completely cooked meats, and meat dishes such as Swedish meatballs and beef stroganoff will be prepared and frozen. Accordingly, the demand for commercial home economists trained to develop, prepare, and test such products will rise at least as fast as sales growth trends. Post-high school training in food technology and chemistry is desirable.

Boning, the final production step in animal slaughtering, will become increasingly important due to the necessity of preparing large quantities of meat for convenience food processing. Blade, chuck, beef, and hog boners and butchers will be required in increasing numbers since the meat will be processed further and cut finer than ever before. Boning and butchering, unlike the less intricate skinning and pulling operations, is not likely to be automated or mechanized.

2. The Trend Toward Frozen Foods and New Canning Techniques Will Create Occupations and Expand Others in Canning and Frozen Food Plants

The general food industry problem of a lack of microbiological quality control will become particularly acute in that sector producing frozen foods--both raw and convenience. Microbiological quality control technicians will emerge as an occupation performing bacteria count--called plate counts--chemical tests, vitamin sampling, and other services both in processing plants and retail outlets. The number of such positions is difficult to estimate--the magnitude should be substantial enough to warrant a vocational need survey particularly as Food and Drug Administration enforcement increases. Several levels of technicians will be required ranging from a level at which high school chemistry courses of an applied nature would suffice to levels at which college level microbiology and statistical sampling would be required. For the higher levels a two-year post-high school curriculum seems appropriate.

3. Trends Toward Quality Control and Mechanization Will Affect Occupations in the Dairy Products Sector

Dairy industry processing plant occupations involve the separation, heating, cooling, mixing, curding, forming, freezing, and drying of milk and cream preparations and allied products such as malted milk and ice cream. Prepared mixes for soft ice cream have become an important product, and their manufacture has been mechanized. The dairy product sector includes occupations concerned with the collection of milk and cream from farms and those concerned with distribution to retail and wholesale outlets.

In addition to the microbiological quality control technician position described above, quality control assistants jobs will become available. Those positions can be staffed by high school graduates receiving on-the-job training if a secondary school chemical and biological orientation is obtained.

4. Major Mechanization Steps Have Already Been Taken in Baking Plants; Specialty and Sweet Goods Items Will Be in Growing Demand; Local Full Service Bakeries Will Decline

A trend from local to centralized specialty baking has caused a decline in the number of full service bakeries. Supermarkets are replacing the local bakeries as the primary retail outlet. In many cases displaced local bakers can find jobs in bakery goods plants but will face the challenge of working with modern instruments for the first time. In this respect there is an analogy between the adjustments and retraining facing the baker and that of the process controller in a steel mill.

Youth entering the baking industry will find positions such as quality control assistant and continuous baking equipment maintenance technician open. The next generation of baking industry workers will need a knowledge of instrument and control technology to replace and supplement the craft and sensory skills of their predecessors. An excellent review of baking occupation data relevant for vocational education planning can be found in the 1966-67 edition of the United States Department of Labor Occupational Outlook Handbook.

D. IMPLICATIONS FOR PROGRAM PLANNING

Food industry processing plant employees will be required to have greater knowledge of chemistry and control. Specialty food bakers and those concerned with quality control should be knowledgeable with regard to textures, acidity, fat composition, bacteria test counts, and sensory evaluation.

Instrumentation and control of continuous dough mixing equipment, pressure canning retorts, and quick freezing equipment will place a premium on electronics and control mechanism familiarity of almost all employees in bakery plants. The demand for persons with a commercially oriented home economics background will continue to rise.

THE CHEMICAL PROCESS INDUSTRIES

A. INTRODUCTION AND GROWTH OF INDUSTRY EMPLOYMENT

Several industries such as chemicals, petroleum, rubber, plastics, stone, clay, and glass have commonalities in the similarity of their manufacturing processes although the raw materials used and the end products produced are quite diverse. This similarity of processes and processing operations applies to occupations and their skill requirements and justifies their being classified under the category chemical process industries. Common technological changes are likely to affect these industries and hence the present and future nature of the jobs within them.

The importance of the industry to Illinois is aptly demonstrated by a total 1963 employment figure for the sectors noted above of nearly 120,000; 18,000 of which were in plastics or plastic products plants.

With several notable exceptions, sales growth within the chemical industries should approximate 5% per year over the next decade. This estimate is based on a projection of past trends and U.S. Department of Commerce data. Productivity data was not available but substantial increases in manpower productivity can be inferred from past trends and anticipated technological developments. During the 1950-60 period, when the chemical industry sales grew nearly 20% per year, the number of production and technical workers grew only 5% per year. If the same ratio of employment to sales growth holds during the 1965-75 period, employment growth will be quite small--less than 1 or 2% per year.

More dramatic sales growth will appear in the plastic and adhesives sectors. Recent trade journal projections call for a doubling of 1965 plastics consumption by 1975. With plastics plants already a significant factor in Illinois, vocational educators planning for facilities in proximity to those plants, can expect a substantial increase in employment. Industrial adhesives market growth has yet to be clearly established and many plants devoted to their production yet to be established; therefore, definitive data on employment magnitudes is not available.

B. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

Technological developments in the chemical process industries fall into two general categories: (1) process technology, which includes automation and instrumentation of production techniques and the development of new production methods; and (2) product technology, which is experiencing a proliferation of custom blended chemicals and new products.

In all five chemical process industries the trend toward automation and instrumentation will increase the demand for and increase the skill requirements of maintenance and operating occupations such as

- Instrument repairmen
- Pipefitters and millwrights
- Electricians
- Maintenance machinists
- Process equipment operators

Instrument repairmen will work under closer supervision from instrument and control engineers maintaining equipment of increasing electronic, pneumatic, and hydraulic sophistication. Custom designed feedback and control equipment will be tested by instrument technicians who have completed advanced training in technical courses. Process equipment operators must place increasing reliance on instrument readings rather than their own sensory perceptions. The transition these operators will be facing is similar to that which will face steel mill operators.

Because of recent shortages of qualified process equipment operators and technicians, it is not uncommon for companies to use graduate engineers on shift work. The personnel director of a major downstate soybean refiner and agricultural chemical producer stated the problem and its solution thus, "We would prefer to use vocationally trained technicians in those positions but an insufficient supply exists. We have long wished to develop a cooperative training program but no mechanism exists to establish such a program and efforts to date have failed."

C. PROGRAM PLANNING IMPLICATIONS

Core high school courses in chemical, electronic, hydraulic, and mechanical principles would serve as a valuable background for chemical process industry job candidates.

Several employers cited instances in which graduates of out-of-state technical institutes and vocational high schools had been hired because no qualified local candidates existed.

Other interviewees including government and industry officials felt a need to detach program planning and development from the universities. They were of the opinion that programs planned by university personnel tended to emphasize theoretical principles at both the high school and post-high school level and hence either overtrain or discourage candidates for jobs in or related to chemical technology.

THE METALWORKING INDUSTRY

A. INTRODUCTION

The metalworking industry as defined in this report is an occupational group consisting of metalworking occupations in Standard Industrial Classification industries, such as fabricated metal products, nonelectrical machinery, instruments and related products, transportation machinery, and ordnance equipment and accessories. Since these occupations represent a cross section of industries, manpower projections cannot be made as they were for other industries surveyed. Projections must be made on an occupation-by-occupation basis.

B. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

Two breakthroughs stand out as major developments in metalworking technology. One will have immediate effects on occupations, the other is expected to have only minor impact until 1975 or later.

1. Electronic Metalworking

The environment and performance requirements of the missile and space programs necessitated the use of such exotic materials as tungsten, titanium, superalloys, and refractory metals which cannot be machined or formed by conventional metalworking techniques. Among the important techniques developed to handle these new metals are plasma-arc metal cutting, melting and welding, electron and laser beam welding, and magnetic forming. Several of these new processes, particularly those based on electronic principles, will eventually reach a state of refinement such that they are likely to supplement, and in some instances, even replace conventional metalworking techniques. Until 1975 or 1980 electronic metalworking is unlikely to play a major role in industries other than aerospace and hence, will have only a minor impact on metalworking occupations in Illinois.

2. Numerically Controlled Machine Tools (N/C)

Numerical control is one of the most significant new developments in manufacturing technology since Henry Ford introduced the concept of the assembly line, because it brings to job shop production many of the economies of manufacturing now available only with highly automated production systems.

Because N/C has received a good deal of fanfare and publicity recently, the tendency has been to overestimate the impact of this admittedly significant development. N/C has already reached a state of development that makes it economically feasible for many low-volume and most medium-volume industrial working applications. However, it will have no impact on those operations in the automotive industry, for example, where volume is high enough to justify single-purpose machines or transfer lines. In smaller shops, it may be many years before the relatively inexpensive machine tools now employed (worth $1000 or less) are replaced by N/C machines (minimum cost $8000-$10,000). Over 15% of all machine tools fall into the single-purpose, mass production category, and nearly 40% now fall into the under-$1000 category.

Numerically controlled machine tools are provided instructions in the form of coded numerical instructions on punched paper tape, which direct the equipment to position the part to be machined, control the flow of coolant, select the proper machining speeds and feeds, control the entire machining operation (drilling, milling, boring, turning, etc.) and in many types of equipment, even select and procure the proper cutting tools for each operation.

3. Emerging Occupations Related to N/C

In conventional machining, all of the operations described above were performed and controlled by the hands of the machine operator. In N/C programming, speed, feed, and cutting tool specifications depend on the skill of the person writing the machining instructions to be converted into punched tape.

The occupational structure of the machine shop, old and new, is shown below.

Conventional Machining	Numerical Control
Machinist	Machine Tender
Master Machinist	Parts Programmer "B"
Experimental Machinist	Parts Programmer "A"
Toolmaker "A"	Toolmaking Technician
Toolmaker "B"	N/C Electromechanical Maintenance Technician

These occupations do not include those related to computer applications since the digital computer is an optional, not an essential, component of N/C systems. The computer is often used only to hold in memory and make computations based on tables of speeds, feeds, and tools used for various metals to be machined. Its primary use is as a preprogramming aid for the individual who develops and tapes the machining programs.

Parts programmers write programs to guide the machine in machining a given part. A distinct programming language has been developed and a knowledge of the proper speeds, feeds, and cutting tools essential for the programmer to perform his duties. Exhibit 11, page 79, contains a

Exhibit 11

JOB DESCRIPTIONS--NUMERICALLY CONTROLLED MACHINE TENDER

Duties Performed

Sets up, sequences, and monitors a numerically controlled machine tool. Presets tools in rotary cutting tool holder, mounts part in holding fixture, mounts holding fixture on machine, loads machine control tape, and starts machine. Observes machine performance, corrects minor and reports major malfunctions. Proofs control tapes for parts programmer.

Skill Requirements

Manual requirements include use of precision measuring instruments and dexterity in handling fixtures. Able to make visual inspections of condition of cutting tools. Modest amount of machining experience.

Cognitive requirements include basic mathematics and some trigonometry to read blueprints. Modest amount of knowledge regarding speeds and feeds as they relate to the machinability of various metals.

Relationship to Other Allied Occupations

Depends on the parts programmers for knowledge of machining techniques, speeds, feeds,and cutting tools since programs are dependent on such factors. Calls maintenance personnel to perform major adjustments and repairs.

Source: IIT Research Institute

References: Dictionary of Occupational Titles, Third Edition
Outlook for Numerical Controls of Machine Tools, Bulletin No. 1437, U.S. Department of Labor, March 1965

description of the duties of the N/C machine tender. Many of the skills formerly associated with the machinist position (not a machine tender) are being shared by the parts programmer and the machine tender.

Toolmaking technicians require a higher level of theoretical knowledge--metallurgy and mathematics--than their tool and die maker counterparts. As an emerging occupation, they represent another of a group of similar occupations born of a need to support engineering positions by using highly skilled technicians in the place of engineers.

4. Illinois Employment Projections for Specific Occupations

Assuming 25% of the machine tools in Illinois metalworking shops will be numerically controlled by 1975 and a steady growth, year by year, the following annual demand for N/C occupations can be anticipated.

Parts Programmers "A" and "B"	500
Machine Tenders	800
Maintenance Technicians	100-200
Toolmaking Technicians	150

The sources of employees to fill these jobs will be discussed in Section C below.

C. IMPLICATIONS FOR PROGRAM PLANNING

N/C will not make present high school or area technical school machine shop facilities obsolete since at least one-half of all machine tools will remain conventional and since experience and skill on conventional machines will provide the background required by all N/C occupations.

The current demand for machine tenders and parts programmers is generally filled by retraining of displaced machinists and master machinists. Machinists whose experience is great and who pass aptitude tests, are given programming courses and thereby qualify as parts programmers. Other machinists of lesser ability are being converted to machine tenders.

The future role of vocational education can be twofold. As the supply of machinists who qualify for parts programming training dwindles and as those who have been retrained retire, openings for qualified youth will appear. High school machine shop courses revised to include a period of parts programming per day, for as much as a two-year period, could effectively train programmers who had access to feed and speed tables covering a wide range of metals to be machined.

The addition of one numerically controlled machine tool to a high school shop (an N/C punch press adequate to train tenders in most N/C principles can be purchased for under $10,000) would allow the shop to produce graduates with an N/C as well as a conventional machine orientation.

THE OFFICE INDUSTRY

A. INTRODUCTION

The office industry as defined in this report includes male and female clerical, secretarial, and data processing jobs in a wide range of industry sectors, including manufacturing, retailing, wholesaling, banking, insurance, and professional services. The office industry occupations to be discussed represent an occupational group covering an even broader cross section of industries than the metalworking occupations group.

B. GROWTH OF INDUSTRY EMPLOYMENT

Although industry aggregate manpower growth estimates are more difficult to make for occupational groups than for relatively discrete industries, some indication of overall employment magnitudes is available.

Manpower productivity in the office occupations rose substantially during the past decade and will continue to rise at approximately the same rate until 1970 when the impact of additional technological changes, to be discussed below, will be felt.

During 1960-65, office industry employment rose 3% per year in the Chicago Metropolitan Area. Due to the movement of some corporate headquarters staffs to St. Louis and Chicago, the downstate increase was slightly lower.

Office industry employment in the Chicago area alone surpassed 600,000 during 1966 according to a recent Corplan and Chicago Association of Commerce and Industry survey.

C. TECHNOLOGICAL CHANGES AND THEIR OCCUPATIONAL IMPLICATIONS

A review of the several major categories of technological changes affecting office industry jobs is essential as background for the assessment of future skill requirements. However, in presenting occupational data, jobs related to computer technology will be treated only briefly, since they have been evaluated at length in much of the current literature. (See the Bibliography of Published and Unpublished Vocational Education Literature for numerous references.)

The three major technological changes are the electronic computer, the optical scanner, and direct data collection and transmission. Each of these changes will have an impact on the structure of the labor force. A reduction in demand for semi-skilled and unskilled female workers and, to an extent, male high school graduates can be expected. At the same time, a critical need will arise for computer personnel, data processing maintenance workers, and office and related white-collar workers with a technical background.

Occupations to be discussed are related to the operation of computer and optical scanning software, the maintenance of computer hardware and software, technically related occupations, and supporting clerical employees. Most occupations related to computer hardware and programming have been adequately treated in existing literature.

Optical scanning equipment operators will supplement key-punch operators until 1970 and then begin replacing them. The job skill requirements are relatively low with the exception of operators on machines that perform editing and format functions.

Software technicians and electromechanical technologists perform maintenance and adjustment functions of a mechanical and electronic nature. Tapedrives, card readers, card punchers, high-speed printers, and magnetic drums contain electric motors, pulleys, and gears controlled by electronic servomechanisms. In order to service these devices, repair procedures for the electronic components and the mechanical parts are required.

These occupations also exist as a test and final inspection function in manufacturers (IBM, Honeywell, Burroughs, NCR, etc.) plants.

The general trend of separating engineering occupations and providing assistants for professional people such as physicians, lawyers, and engineers has created a demand for several new categories of office workers. The skill requirements of those occupations encompass not only office skills--typing, filing, stenography, record keeping--but a technical vocabulary, technical editing abilities, and an orientation in the principles of the technical specialty of the person for whom the office employee works.

Examples of these occupations include the technical secretary (secretary to a scientist or engineer), medical secretary, professional engineer's aide, and archive and library assistant.

Supporting clerical employees. In addition to the employees engaged in directly preparing input data, nearly one-quarter of all computer-related personnel will be engaged in supporting tasks involving coding, collating, storing, and disseminating source and computer documents. These occupations will include coding clerks who convert information into predetermined codes for subsequent use by keypunch operators, magnetic tape librarians, who classify, catalog, and maintain magnetic and paper tape libraries, and scheduling personnel.

Software printed output must be collated and disseminated by collators and data distribution clerks.

D. IMPLICATIONS FOR PROGRAM PLANNING

Inauguration of data processing educational programs at the high school level in such areas as software operators, computer operation, equipment maintenance, and keypunch operation continues to be called for since recently started programs are unlikely to meet future manpower demand.

Business education curricula revisions including technical terminology and editing courses would serve to more adequately prepare male and female high school graduates for technically related office jobs. If possible, technical orientations for office industry entry jobs could be articulated with post-high school programs providing an opportunity for employees to upgrade their skills in adult evening or full-time post-high school programs.

The male engineer's assistant could thereby aspire to become an engineering technician, and the scientific secretary could aspire to become a laboratory technical assistant or technician. The ladder to reach occupational aspirations would be provided by continuous educational programs from the high school through the post-high school levels.

V. INFORMATION ON OTHER ASPECTS OF VOCATIONAL AND TECHNICAL EDUCATION

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The vital elements of the vocational education mechanism--teachers, guidance, administration, etc.--must function if programs are to be developed which will provide students with the experience, knowledge, and skill with which to qualify for tomorrow's jobs. This section discusses information developed during the survey which should serve to suggest improvements to be made in that mechanism.

A. THE SUPPLY OF TEACHERS

Approaches used by other agencies also concerned with the broad task of education came to our attention during the survey.

- A teacher referral service, similar to those used by colleges, universities, and professional disciplines, could maximize the effective use of scarce teacher personnel and help local school administrators to fill vacancies.
- Job Corps camps secured teachers by offering relatively high salaries, by a continuous want-ad campaign, and by encouraging retired teachers to enter retraining programs and return to teaching on a half-day basis.

Industry executives were asked to suggest how they could help vocational educators secure an adequate supply of teachers. On the subject of industry internships, they felt negatively inclined toward short duration summer programs. A sounder approach encompassing one to two years of industry work experience after completing an undergraduate or technical school program was suggested. Such a program would clearly be designed to release the person for teaching duties--a contract could ensure that the firm would not retain the employee's services beyond a set program period. The future teacher would then return to school for a Master's degree.

Certification, academic requirements, and experience standards combine to limit entry into V&TE teaching. Specificity of certain narrow fields may also be inhibiting.

B. COUNSELING AND PLACEMENT

A dual approach to upgrading the skills has been suggested by two pilot programs conducted in the state this summer. In downstate schools, the chief counselor and the placement officer are usually one and the same person.

At Western Illinois University, Dr. Norman Severinson conducted a week-long workshop for rural guidance workers, including guest speakers on topics such as technical school programs, industrial job surveys, and occupational implications of technological change.

At the Illinois Institute of Technology, counselors were trained to relate to their students and provide an awareness of the traits, attitudes, and motivations expected by employers.

Today's counselors need a closer acquaintance and dialog with the industrial environment and tomorrow's counselors need some personal experience with the job world before entering the teaching and counseling profession.

C. THE NEEDS OF UNDERACHIEVERS AND POTENTIAL DROPOUTS

Several suggestions have been made to provide relevant educational training for the youngster who has a low tolerance for academic courses.

The applied science and vocational courses suggested as a major conclusion of this report would aid the student in relating course work directly to an occupational interest--a vital step in preventing high school dropouts.

Cooperative education programs--successful only where the employer gets a fair day's work--could be expanded and improved by better rapport between industry and the schools.

Reduction of "required" courses which are not applicable to the needs of lower level students is another important alternative which should be considered.

D. THE ROLE OF POST-SECONDARY AND ADULT EDUCATION

Post-secondary education including short-term to three-year programs are vital in a period of expanding technical skill content for many industry occupations.

Adult education programs are vital for several reasons:

- High school dropouts are more likely to return to an evening school program.
- Entry jobs are now available--particularly in the office and health fields--for program graduates.
- Evening programs could be staffed by industry personnel.
- Greater use of relatively expensive modern shop equipment could be attained and cost per pupil lowered.

E. THE STATUS AND PRESTIGE OF V&TE

Several factors appear to hold a potential for higher V&TE status and prestige. The status of teachers, students, jobs, and courses will be affected.

Emerging occupations, because of their relation to new technology, generally are accompanied by acclaim and rapid acceptance in corporate work environments.

Local school officials feel that as the quality of instruction, course content, and entry jobs rise, the image of vocational education will rise proportionately. This has been demonstrated in communities where vocational courses formerly operating at 50-75% of classroom or laboratory capacity, are fully registered as a result of a program to demonstrate to students and parents the excellent working conditions and financial rewards of technical jobs. This category of jobs is being looked on as akin to white-collar rather than blue-collar work. The term "technology" has gained prestige and along with "technical" has been used in a very broad context in this report.

F. ORGANIZATION AND ADMINISTRATION OF V&TE

V&TE organization, administration, and planning effort should take cognizance of rising shop and laboratory equipment costs, program planning assistance sought by local school administrators, and factors which affect industry's willingness to work with educators.

Shop and laboratory equipment costs may have a great deal to do with the decision to provide local or area school facilities. In graphic arts, where a single Linofilm machine may cost $50,000 or more, an area school may be a logical place to locate such equipment. On the other hand, a local school in proximity to a concentration of employers in the metalworking field could equip its shop with a numerically controlled punch press for under $10,000.

Local program planners expressed a desire for additional program planning assistance and a willingness to share responsibility with state level staff members. Statewide planning is essential to prevent duplication of local school effort.

The size and nature of industrial plants in a given geographic region can provide a preliminary index of industry attitude toward the school system. Plants with an employment level of 1000 or less (regardless of the size of the parent corporation) are more likely to cooperate with local industry since the plant's scale of employment is too small to permit in-plant training classes. Several firms in southern Illinois expressed a desire to work with persons responsible for the planning of vocational education programs to develop, in school, afternoon or evening curricula for occupations in each of their respective plants.

VI. INFORMATION GAPS AND RECOMMENDATIONS FOR FUTURE RESEARCH

VI. INFORMATION GAPS AND RECOMMENDATIONS FOR FUTURE RESEARCH

This section outlines the nature, the need, and the priority of research projects that should be undertaken by the Division of Vocational Education to provide for long-term effectiveness of its educational programs. These projects are means by which gaps in information needed to plan and develop vocational education in the state could be filled. They are assigned to three groups. The projects given the highest level of consideration are discussed under the heading of Priority A. Each project description is followed by a discussion of the major reason for its inclusion.

Because of rapid social, technical, economic, and educational changes in Illinois, all recommended projects are designed to offer significant benefits to vocational education if they are performed within the next two to three years. After that time, the relative pertinence of some or all of the projects might be altered substantially.

A. PROJECT 1: PRIORITY A. TASK FORCE FOR COOPERATIVE EFFORTS WITH INDUSTRY

An enduring and universal need for increased liaison between schools and industry was evidenced during numerous interviews with industrialists and educators. This need is related to the occupational skill requirements of changing technology in Illinois industry, not labor shortages due to the present stage of the business cycle.

Potential task force accomplishments include the following:

- Arrangements for more part-time teachers from industry
- More and better cooperative education programs

- Workable plans to meet demands for adult evening programs
- Cooperative use of educational facilities
- More apprenticeship program use of educational facilities in area vocational schools
- Arrangements for teacher training programs

Establishing a workable and effective task force requires careful planning. The essence of an effective effort would be a continuous fruitful relationship between industrially minded educators and interested businessmen. Corplan suggests that several industrially oriented persons, possibly a retired industry executive of stature, a scientist, or an engineer, be added to the state staff. Such persons could spearhead a task force composed of the six to ten members best acquainted with industry in their respective parts of the state.

B. PROJECT 2: PRIORITY A. ADDITIONAL OCCUPATION AND PROGRAM PLANNING DATA FOR EMPLOYMENT SECTORS OUTSIDE THE SCOPE OF THIS STUDY

Although this study was subject to limitations in scope and duration, fragmentary information generated indicated three other employment sectors of potential inquiry. Each area currently employs over 100,000 persons in the state and is experiencing and will continue to experience numerous technological changes. A brief description of occupational changes expected in the employment sectors appears below. Corplan suggests that research along the lines of this study be conducted in each of the three areas.

1. Construction occupations will change as a result of new building materials and subsequent changes in both building trades and building service jobs.
2. Transportation occupations, particularly those connected with passenger service, are likely to expand rapidly within the state.

The study team noted a lack of information on occupational training, manpower supply, and manpower demand for this occupation.

3. Marketing occupations concern all industries and companies that employ salesmen, saleswomen, service advisors, and field representatives. Examples of agricultural marketing occupations of a subprofessional level are the field service technician and the implement salesman.

C. PROJECT 3: PRIORITY B. REGION-BY-REGION STUDIES OF THE SIZE AND NATURE OF INDUSTRIAL PLANTS

To establish precise parameters for vocational-education program and facilities planning, detailed information must be developed on a regional basis. With the background of technological and related occupational data provided in this report and the identification of industries and companies located in particular regions of the state, planners can anticipate the occupations expected to emerge, expand, and change with regard to local and area vocational school facilities.

Corplan has noted distinct patterns of industrial concentration that could serve as guidelines for regional studies. A list of these regions and several of the most important industries in each is noted in Exhibit 12, page 94.

Employee mobility, frequently cited as an objection to the regional approach is, in Corplan's opinion, less of a factor than expected. Interviews indicated that most youths residing in a given part of the state will ultimately be employed within commuting distance of their birthplaces.

Data generated by the regional studies should include most of the following for each key regional industry:

- Current employment in major vocational and technical occupations--inventory by occupation

Exhibit 12

INDUSTRIAL CONCENTRATION OF SELECTED REGIONS

East St. Louis and Vicinity

Primary Metals
Chemicals

Southern Illinois

Electrical Appliances
Food Processing

Quad-Cities and Vicinity

Agribusiness Machinery and Equipment
Industrial Controls

Peoria and Vicinity

Primary Metals
Transportation and Construction Equipment

Central Illinois Including Springfield and Decatur

Office Industry
Electronics and Electrical Equipment

Eastern Illinois

Food Processing
Electronics and Electrical Equipment

Chicago Metropolitan Area

All Except Agribusiness

Rockford and Vicinity

Metal Fabricating and Metalworking
Electronics and Electrical Equipment

- Projection of sales growth for key firms and comparison of the growth with national averages
- Incorporation of data on manpower productivity
- Actuarial and retirement data for replacement requirement projections
- Development of figures for additions to labor force from sales and manpower productivity projections
- Analysis of ability of current and anticipated manpower supply sources to meet future demands

D. PROJECT 4: PRIORITY B. STATE VOCATIONAL TEACHER REFERRAL SERVICE

To maximize effective use of scarce vocational and technical education personnel, establishment of a central source of information on such personnel was suggested by numerous interviewees, including local school administrators. The intention of this recommendation is to establish a central source of information, not a complete placement service.

A referral service could perform the following services:

- Identify employment opportunities for teachers who desire to relocate
- Provide statistics on the ages and the specialization of teachers on a statewide basis
- Serve as a clearinghouse for personnel from other states
- Provide assistance to industry personnel seeking part-time teaching appointments

E. PROJECT 5: PRIORITY C. MANPOWER NEED STUDIES FOR FARM-RELATED OCCUPATIONS

Surveys of firms providing farm services--agricultural equipment manufacturers, feed and seed distributors, and farm service bureaus--could provide definitive data on the magnitude of farm-related occupational manpower requirements. An example of data generated by a pilot survey made by Corplan for one occupation is presented in the section on agribusiness. During the study, little information on future manpower supply and demand for other occupations was uncovered.

For key occupations relating to farm delivery and field technical service jobs, information on the following factors could be generated:

- Current supply, demand, and shortages
- Requirements for additions to the labor force
- Requirements for replacements
- Manpower available from current and future sources of supply

F. PROJECT 6: PRIORITY C. INFORMATION TO PROVIDE ARTICULATION OF HIGH SCHOOL AND POST-HIGH SCHOOL PROGRAMS

Interviewees familiar with academic and in-service programs in electronics, chemical technology, and health services frequently cited duplication of effort and overspecialization as characteristic problems confronting both program administrators and students. A lack of career flexibility discourages youth and adults from entering these fields.

It is difficult for graduates of basic technology programs who have held jobs for a period of time to enter programs requiring advanced technology qualifications without repeating a substantial portion of the basic technology programs. For example, the electronics technician finds it difficult to apply technical school credits toward a degree in electrical engineering. The certified laboratory assistant must start over to qualify as a medical technologist. Military electronics schools are good examples of course and program articulation achieved through a common-core basic curriculum.

By-products of such information would aid in the development of high school courses providing foundation, introduction, and motivation to enter these fields.

G. PROJECT 7: PRIORITY C. CENTRAL CLEARINGHOUSE AND LIBRARY FOR OCCUPATIONAL DATA RELEVANT TO LOCAL SCHOOL PROGRAM PLANNING

In addition to the bibliography provided as an adjunct to this report, other aids are needed by state and local vocational-education program development personnel. A central agency to help in the location of sources of pertinent information and a ready supply of key publications and reports on manpower trends, projections, and changing occupational skill requirements is recommended. Such an agency would be staffed by persons familiar with information sources and capable of providing practical suggestions to inquirers.

The agency would be both complementary and supplementary to the information-retrieval capabilities of central ERIC and its satellite centers, such as that under development at Ohio State University.

TEXTNOTES

TEXTNOTES

[1] In 1964 Corplan Associates completed an exhaustive study of the impact of technological change on the printing and publishing industry in metropolitan Chicago. The study, sponsored by a group which included the City of Chicago, Department of City Planning, and the Ford Foundation, also made a basic forecast for the industry on a nationwide scale. Numerous industry forecasts were reviewed during a literature search that included 23 trade journals; forecasts were made on the basis of over 30 interviews with industry personnel.

[2] Except for Federal Reserve Board printing index data.

[3] Standard and Poor's Industry Surveys, Publishing, April 21, 1966, page 25.

[4] U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1963.

[5] A Corplan study for an industrial client revealed that electronic photocomposition will have only limited application to printing shops performing nonrepetitive work (tags, tickets, advertising printing, coupons, and art reproduction).